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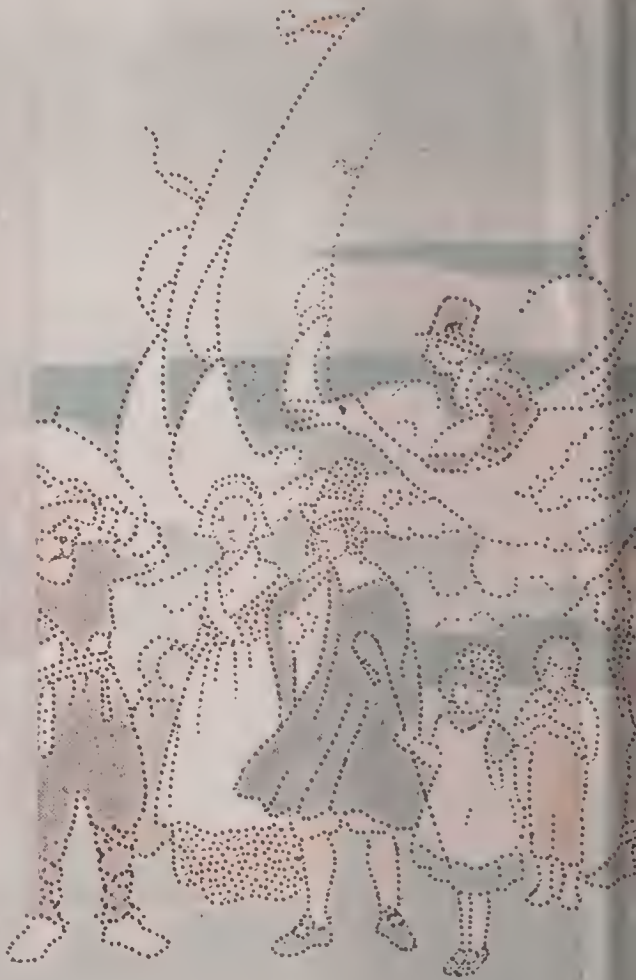


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Hilda Hanway

Ambition



WE ARE living at a time when to be young is the proudest thing in the world. The world will be a fine place to live in when you grow up. What are you going to do in it? Are you going to muddle through somehow until the dark gates open that lead into another life, or are you going to make yourself known and felt and become a power for good?

“Nothing can keep you back if you mean to go forward. The roads that lead to success are widening more and more. You may wander in a hundred fields and pick your prize.

“There are low ambitions and high ambitions. Let us see that we aim at a high purpose. In Emerson’s splendid words, let us ‘hitch our wagon to a star’.” (See page 107)

AMBITION



COMPTON'S PICTURED ENCYCLOPEDIA

VOLUME I

To inspire ambition, to stimulate the imagination, to provide the inquiring mind with accurate information told in an interesting style, and thus lead into broader fields of knowledge, such is the purpose of this work



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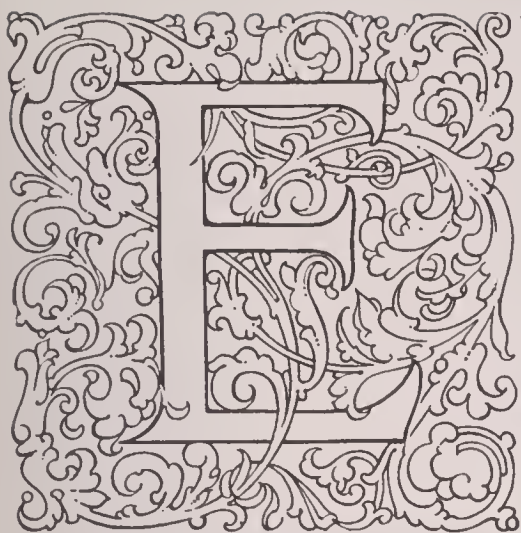
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Foreword



VERY day of our lives there come to us the wishing moments—the times when, in the face of what is or what we are, we wish to be otherwise or in other places. If at such a time there should come to us an angel of light with an offer to fulfil one wish, how many of us would ask that we might live our lives over again? How many, when asked for a reason, would answer in terms that meant, however expressed, a desire to recover lost opportunities for a better education, a richer and more varied life, knowledge that would close the door to error and open it to opportunity? How many, in brief, would answer in terms that meant access to books and the command they give us over the world of today and tomorrow?

The wonder is not that such wishes come, but that we do not know that their fulfillment is offered us in good books, and if not for ourselves, at least for our children. With them we can live our own lives over again. In a home where there are books there is the opportunity for renewing youth by learning together, and thus holding together three of the elements—the home, the school, and the child—on which the happiness and security of today and tomorrow depend.

We are talking much today, too much perhaps, of the school and the teacher's work and responsibility in educating the child. The new emphasis must become again the old emphasis upon the home and the parent: what we have left to the school and the public library we must in some degree recover for the parent and the home. One sure factor in working such a recovery is ability on the part of the parent to follow and share in the child's desire for knowledge; and, if the desire is dormant, to awaken it with pictures and books. The school and mere textbooks cannot do all. The public library cannot be substituted, for our average expenditure per capita for libraries the country over is only twenty cents. Books and the power to read are no longer a luxury for the privileged few. Universal education has made them the necessities of all, whether adult or child; and the joy of learning and the companionship and content of common interests are now open to every home where the printed and pictured page brings the wide world before parent and child alike. The work of the school is thus strengthened for the child, and continued and renewed for the adult. Age is banished; life is not only richer and more varied, but it becomes the wish fulfilled of a new life with new opportunities, deeper meaning, and multiplied pleasures.

I have said these things because I believe they should be said and because they are the views, the philosophy, if you please, of those who are responsible for the writing and publishing of these volumes. They have put this faith into every page and before the thought of making and selling books for profit.

This work expresses another belief, and that is that the foundation of a collection of books in home and school is an adequate, interesting, and inclusive work of reference. Two classes of works have attempted to meet this need. In the first group fall the many-volumed, technically written, expensive encyclopedias, whose merits we all acknowledge but whose heavy articles befog the average reader. In the other group are the works designed for popular use or for the use of children, interesting, certainly, but for the most part limited in scope and haphazardly arranged.

Now somewhere between the work for the specialist and the Sunday supplement style there is a place for something different and more generally satisfying to all ages, something that the adult and the reading child can use with satisfaction and pleasure, something that a scholar will respect and that a beginner will appreciate. Such a work may be inclusive yet selective, accurate and at the same time interesting. Facts are not forbidding in themselves. The shallow sensationalist shuns them, but not the reader who respects his own mind and demands that others respect it. The honest-minded child—and every child is essentially honest-minded—seeks facts and will be satisfied with nothing less. All that he asks is that they shall not be rammed down his throat by a Gradgrind sort of writer.

Knowledge is attractive, real information is a pleasure. Wonder grows with true learning. It is a high aim to inform and interest, to teach and inspire, to be accurate and still use words of few syllables. I can say for every writer in the long list of contributors to this work that this has been his aim, and that more consciously and conscientiously than ever before their combined aim has been a work, not only readable, but bound to be read at whatever page you open it. What we have aimed to make, in brief, is this:

An encyclopedic, alphabetically arranged survey of the whole field of knowledge, presented with such freshness, vividness, and alluringness, and embellished with such a wealth of illustration, that it should be as readable as a storybook, without anywhere sacrificing scholarly completeness or accuracy.

To put it in another way, our governing purpose throughout this work has been fourfold: (1) scholarly accuracy and breadth of view; (2) interesting treatment, obtained by focusing the attention on the most striking, salient, and picturesque aspects of each topic discussed; (3) simplicity, clearness, and directness of language, without insulting the reader's intelligence by trying to "write down" to him; (4) a wealth of illustrations which visualize and dramatize the text.

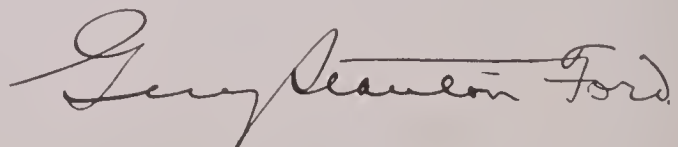
The ending of the World War gave us our opportunity. The map of the world had been made over and one of the most momentous chapters in history had been written. New histories, new geographies, new reference works were demanded. We seized the opportunity to make a work which should not only embody the latest developments along these lines, but should reflect the spirit of the new age in every department.

With the volumes before you, I do not need to point out how the interests of all, from those of the smallest child to those of the most mature mind, have been kept in view. I should like to describe the labors by which accuracy and interest in picture and word have been sought. Many an article represents six revisions and the combined efforts of as many scholars and skilful writers. The list of contributors, special writers, and departmental editors is a roll which would honor any work.

One especially valuable feature of this work is the Easy Reference Fact-Index in the last volume. This is constructed to serve not only as an unusually copious index to the work as a whole, but as a handy work of reference. Thousands of names in geography, history, literature, mythology, and other fields, that one would not ordinarily expect to find in a work of this nature, are here given a place and treated in condensed form; and, so far as it is practical, the salient facts about topics occurring in the preceding volumes are summarized. Pronunciations are indicated for all words that present difficulties. The reader in search of information on any subject should therefore first turn to the proper alphabetical place in the Fact-Index. In many cases he will find there all the information he needs. If not, the page numbers will direct him to the place he should consult in the main volumes.

In closing three years' service as Editor-in-Chief, I may be permitted a few words of commendation and appreciation to all the scholars who have responded promptly and heartily to requests for their aid and coöperation, to the staff of writers, artists, and map-makers who have labored in season and out with zeal and unwavering fidelity to the ideals set at the beginning. Above all I pay tribute gladly to the unremitting labors of Dr. Samuel B. Harding. More than any other single person he has put the stamp of his scholarship and integrity on these volumes.

And I speak not only for myself but for the whole staff when I say that no group engaged in a similar project has had more consistent and loyal support than we have had from the publishers of this work. They have shared our every purpose as here expressed, and have never counted the cost of any plan or request that would make these volumes more nearly realize this new conception of an educational work.



Editor-in-Chief.

PUBLISHERS' ACKNOWLEDGMENTS

The pictures in these volumes form, so to speak, a legion of honor, a select corps chosen from the world's army of illustrations. Of photographs alone, the Art Staff gathered more than half a million from which to make this selection. They came from all quarters of the world—from the albums of explorers and famous travelers, from the collections of scientific men, from official archives, from specialists in remote corners of the globe, from every source, in short, known to international experts in the photographic field.

To these half million photographs there were added in the course of three years' preparation a large number of drawings, photo-diagrams, and illustrations in color, submitted by skilful artists of America and Europe. Then from this rare array were gradually selected the "fittest to survive"—the pictures you see in the ensuing pages. For every illustration you find there, you may know that almost a hundred were cast aside.

Nor was this all. In order to carry out with accuracy and completeness many educational features which had never before been attempted, whole series of photographs and drawings, particularly in the fields of industry, mechanics, and applied science, were specially prepared under the direct supervision of the Art and Editorial Staffs.

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HERE AND THERE

in

Volume One

AT ODD TIMES when you are just looking for "something interesting to read," without any special plan in mind, this list will help you. Divided as it is into broad groups, it offers a fascinating variety of subjects for selection. With this as a guide, you may wander through storyland, visit far-away countries, meet famous people of ancient and modern times, review history's most brilliant incidents, explore the marvels of nature and science, play games—in short, find whatever suits your fancy of the moment. This list contains, however, only a small proportion of the articles in this one volume, and is not intended to serve as a table of contents, an index, or a study-guide. For these purposes consult the Fact-Index and the Study Outlines in Volume Eight.

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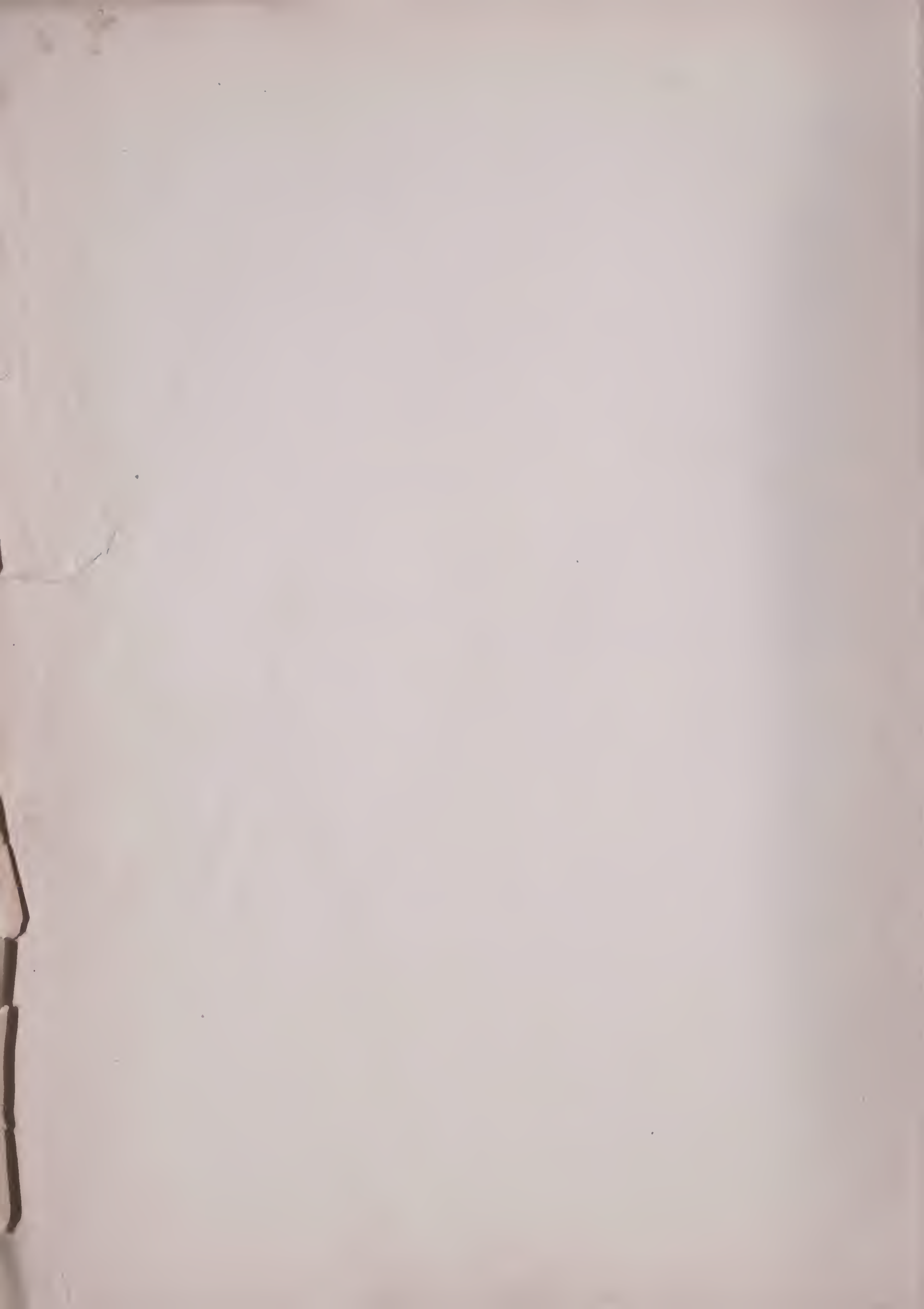
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AACHEN (ä'kĕn), GERMANY. It was the year 1000 after Christ, and the people of Europe, according to old stories, were daily expecting the end of the world.

Otto III, the young and flighty ruler of the Holy Roman Empire, had come to Aachen, the old German capital 44 miles west of the Rhine, and announced that he was going to open the sacred tomb of Charlemagne. This lay under a marble slab beneath the dome of the chapel built by that great emperor himself, with marble columns and other materials taken from the classical structures of Rome, Ravenna, and other Italian cities.

The Ancient Tomb of Charlemagne

When the royal sepulcher was opened the torch's flickering light disclosed a strange sight. The body of the great emperor, clothed in white, was seated on a huge marble chair. One of the hands held a scepter and on the head was the imperial crown. The spirit of the man who 200 years before had founded an empire greater than the world had seen since the days of the Roman Caesars seemed to survive in death. Before the commanding dignity of that huge figure the young emperor quailed. The torch fell from his grasp and he rushed out of the tomb, ordering the stone replaced. Two years later Otto III was buried in that same chapel.

One hundred and sixty years later the emperor Frederick Barbarossa again opened the tomb. The marble throne, crown, and scepter of Charlemagne were taken to add dignity and strength to Frederick's imperial projects, and the bones of

Charlemagne were placed in a shrine north of the chapel, where they remain today. Every seven years they are exhibited to visitors. After Barbarossa,

31 emperors and kings were crowned in the marble chair that had once been the throne of the first great medieval monarch.

The chapel and tomb of Charlemagne, now the central part of the cathedral of Aachen, are the heart of the city even to this day. Aachen is believed to have been the great emperor's birthplace, but it owes its historic fame to Charlemagne's fondness for its hot sulphur springs, which led him to make it his favorite place of residence. These unfailing springs still make Aachen a famous resort, where visitors seek health from the warm waters in which the mighty ruler of the Franks splashed and swam nearly 12 centuries ago.

Nearby Charlemagne built his palace and held his court. Here were gathered the great scholars of the day, teaching in the Palace School, and the gay life of the court went forward as merrily as it does now in the modern hotels which have replaced the ancient buildings.

Treaties of Aix-la-Chapelle

Two important treaties were concluded at meetings or congresses held in Aachen, or Aix-la-Chapelle as it is named in French. The first, signed in 1668, ended a war begun by Louis XIV of France to enforce certain rights claimed in behalf of his wife in what was then

the Spanish Netherlands (now Belgium). The other, in 1748, ended the struggle known as the War of the Austrian Succession.

WHERE THE DEAD EMPEROR SAT FOR THREE HUNDRED YEARS



"On this chair—a crown on his head, a globe in one hand, a scepter in the other, the imperial mantle over his shoulders, sat Charlemagne in his tomb, in which attitude he remained for three hundred and fifty-two years."—Victor Hugo.

THE CATHEDRAL AND ITS NEIGHBORING SPIRES



This is a view in Aachen, or Aix-la-Chapelle. The cathedral is shown on the left. That peaked and high-arched chapel, which is now a part of the cathedral, contained the bones of the mighty emperor Charlemagne. Nearby are other historic buildings grouped about this historic spot.

Aachen became a part of the kingdom of Prussia in 1815. Today it is an important manufacturing center, because of the coal fields that lie near at hand. Its chief trade is in cloth and silk, leather, glass buttons, soap, timber, and wine. It is one of the chief railroad centers on the German border, and it was from here that the German attack on Belgium was launched in 1914 at the beginning of the World War. Population, about 150,000.

ABBREVIATIONS. In writing compositions and in printing articles in books, magazines, and newspapers, only certain abbreviations are used, which are sanctioned by established custom. Signs like “\$”, “£”, and “&” are not, properly speaking, abbreviations, but symbols, though we can see in the sign “&” the Latin word *et* (“and”) from which it arose. Letters in abbreviations are sometimes doubled to indicate a plural or superlative. Thus *p.* means “page,” and *pp.* means “pages”; *f* in music means “loudly” (*forte*), and *ff* “very loudly” (*fortissimo*). A list of the abbreviations most commonly used in printing will be found in the last volume of this work.

ABELARD, PETER (1079-1142). All was astir about the cathedral of Paris—not the great Gothic Notre Dame of our day, but its plainer and smaller predecessor of the early 12th century. For the morning bell had rung and from the taverns and hospices and boarding-houses a motley stream of students, laughing and chattering in a mixture of Latin and their mother tongues, was pouring into the inclosures to listen to the lectures of the various masters. In the classrooms they sat upon the straw-strewn floor, the right knee raised to support the waxed tablets, and for six or seven hours they industriously took notes. In those early days books were few and the teaching was almost all by word of mouth.

Of all the masters, Abelard was the most learned and the most brilliant. The eldest son of the lord of a village in Brittany, he had left castle, the chase, and the life of a noble to become a scholar.

For a time he himself had studied in Paris; but he soon surpassed his teacher in learning, and at the early age of 22 he too had become a master and had begun to teach. He was especially interested in logic, or the art of reasoning, which was not unlike the debating of today. Later he became proficient in theology also, and was soon known as the leading scholar of his time. Students flocked by thousands to hear his lectures, and his books in hand-written copies—especially ‘*Sic et Non*’ (‘Yes and No’)—were read by all learned men. This book was so called because it was made up of such questions as these:

Should human faith be based upon reason, or no?

Is God one, or no?

Is God a substance, or no?

Are the flesh and blood of Christ in very truth and essence present in the sacrament of the altar, or no?

Then came Abelard’s romantic but unhappy love affair with Héloise, a beautiful and accomplished girl, one of his pupils. As marriage would interfere with his rising in the church, Abelard and Héloise were secretly united. Their union soon became known and they separated in circumstances of the greatest pain and anguish.

Abelard’s popularity made enemies for him among those who were jealous of his influence, and others disagreed with his teachings. For he taught that nothing should be accepted unless it could be *proved* true, while they believed that religious faith should come first. These opponents, led by Saint Bernard, finally triumphed and Abelard was condemned as a heretic by the church. Broken in health and saddened by his unhappy love affair, he retired to a monastery where he soon died. But his fame lived after him, and largely as a result of his teachings the University of Paris soon became the chief center of learning in all Europe.

The noble character of Héloise, as shown in her letters to Abelard after their separation, has won the admiration of all ages. When she died, after long living as a nun, she was buried by his side. In 1800 their remains were removed to Paris, where they now rest in the cemetery of Père-la-Chaise. A figure of Abelard reclines on the tomb and by its side stands a statue of Héloise.

ABERDEEN (*ăb-er-dēn’*), SCOTLAND. Rushing southward every week-day from this fourth largest city of Scotland, go long fish express trains carrying the catch of the sturdy North Sea fishermen—herring, halibut, sole, and the like—to the markets of London; for Aberdeen now rivals Grimsby, the great English fishing port, as a center of the British steam trawling industry.

Aberdeen is situated on a bay of the North Sea, 130 miles northeast of Edinburgh, and is the chief city of northern Scotland. It is sometimes called the “Silver City by the Sea” because of the gleam of its gray granite buildings, especially after a heavy rainfall. In addition to its fisheries and granite quarries it has large manufactures of woolen and linen goods, paper, jams, and preserved foods. There are also large breweries, distilleries and chemical works.

Aberdeen was already an important place in the 12th century. It was burned by the English king Edward III in 1336, but it was soon rebuilt and extended. Aberdeen University was founded in 1494. The city is well governed, and owns and operates its waterworks, electric light plant, street railways, markets, and cemeteries. Population, about 170,000.

ABRAHAM. Two thousand years before Christ, at a time when the Egyptian and Babylonian civilizations were already grown old and enfeebled, there dwelt at Ur in the idolatrous land of Chaldaea—which was at the junction of the Tigris and Euphrates rivers—a man named Abram. And the Lord said unto him:

“Get thee out of thy country, and from thy kindred, and from thy father’s house unto a land that I will shew thee.

"And I will make of thee a great nation, and I will bless thee, and make thy name great."

So Abraham, as he was later named, journeyed westward at the call of God to a new land, and settled in Palestine. There he led a patriarchal life surrounded by his flocks and herds, man servants and maid servants, sons and daughters. Thus he became the founder of the Hebrew nation.

Abraham was accompanied in his migration by Sarai (Sarah), his wife, and by his nephew Lot, whose wife was turned into a pillar of salt at the destruction of the cities of Sodom and Gomorrah. A son Isaac was born to Abraham and Sarah in their old age and became his heir to the exclusion of Ishmael. The intended sacrifice of Isaac at the command of Jehovah (Yahveh) and his rescue is one of the best known stories of the Old Testament. According to the Bible narrative (Genesis xi-xv), Abraham died at the age of 175 years and was buried at the side of Sarah.

ABYSSINIA. When Portuguese explorers in the 15th century first made their way from the coast of the Red Sea into eastern Africa, they found in the midst of its wild mountains what they thought was the kingdom of Prester John, a fabled Christian monarch, whose power, wealth, and magnificence were the theme of many a medieval legend.

There was some basis for this belief, for in the 4th century A.D. Abyssinia, then known as Ethiopia, had been converted to Christianity through the efforts of St. Athanasius of Alexandria. Then the Mohammedans swept over northern Africa in the 7th century, cutting off the country completely from civilization. As the historian Gibbon says, "encompassed by the enemies of their religion, the Ethiopians slept for near a thousand years, forgetful of the world by whom they were forgotten." What the adventurous Portuguese explorers found was a strange remnant of this primitive Christianity.

The Negus Negusti ("King of Kings") of Ethiopia, as the Abyssinian monarchs still call themselves, do not encourage the Prester John theory. They prefer to claim descent from King Solomon and the Queen of Sheba!

Abyssinia is about one and one-quarter times the size of Texas. With the exception of the small negro republic of Liberia on the west coast, it is the only part of Africa which is not under the control of some European country. From the modern capital at

Addis Abeba, in the central part, the country is still governed as a feudal monarchy. Religious leadership has passed to the "Coptic" Christian church of Egypt, and the numerous clergy exercise great influence. In the whole realm there is only one school worthy of the name. A standing army of 250,000 men is maintained by the crown.

The whole male population is warlike, the men rarely appearing in public places without their long curved knives or their spears and shields. Europeans have had several

tastes of their prowess. In 1868 the emperor Theodore III imprisoned the British consul and his followers, and the British Government sent an expedition to free them. The capital was stormed

and captured after fierce fighting, Theodore shooting himself when told that the city gates had given way. Later, during the rule of the famous Menelik, Italy established colonies on the Red Sea coast and sought to extend her power inland. War followed, and in 1896 the Italian army was disastrously defeated at Adowa. Ten years later Italy joined with France and Great Britain in guaranteeing Abyssinia against further losses of territory.

A Country without a Coast Line

All the Abyssinian coast line, however, already had been seized, and today the country is cut off entirely from the sea. The French, with a narrow-gauge railway extending from Jibuti toward Addis Abeba,

control the commerce of Abyssinia, which consists chiefly of hides, coffee, and beeswax. The natives are mostly small farmers and cattle-growers, and honey forms a large part of their diet. Barley, wheat, millet, hops, and tobacco are raised in moderate quantities. The soil is fertile, and most regions yield two crops a year.



HOW ABYSSINIA IS SHUT OFF FROM THE SEA

BAREFOOTED MAGNIFICENCE IN ABYSSINIA



The two gentlemen in the picture wearing shoes are the representatives of the Sultan of Turkey and his aide at the Abyssinian court. The barefooted man on your right, made conspicuous by his barbaric trappings, is one of the high functionaries of the court.

Away from the railway, transportation over the primitive mountains and desert trails is possible only with pack-horses, mules, and camels. The towns rarely exceed 5,000 population, and often move from place to place as the supplies of firewood become exhausted.

Big game is plentiful, especially the elephant, two-horned rhinoceros, lion, leopard, lynx, and jackal. The hippopotamus and the crocodile are numerous in the Hawash River, that strange stream which wanders eastward from the mountains for 500 miles and then is lost in Lake Aussa, 60 miles from the coast. Westward from the mountains flows the Abai, which crosses into the Egyptian Sudan and becomes the famous Blue Nile (*see* Nile). The people of Abyssinia are mostly of mixed Egyptian and Semitic (Arabian and Jewish) origin, with a strong strain of negro blood. Population, about 5,000,000; of Addis Abeba, 35,000.

ACACIA (*â-kâ'shâ*). All over the warmer parts of the earth—especially in Australia, Africa, and South and Central America—are to be found the thorny, pod-bearing shrubs and trees of this great genus of plants, whose clustered flowers and feather-like leaves so much resemble those of the locust tree of the United States that the latter is called the “false acacia.” Gum arabic and gum senegal are produced by certain African species, while the bark of some Australian ones (known as “wattles”) is used in tanning. The pods of a few African acacias (especially that called “neb-neb”) are also rich in tannin, and the seeds of one species of South America are roasted and used as snuff. Other acacias are used in medicine, or (like the “black wood” of Australia) furnish valuable timber for furniture making. In desert regions shrubs of this genus furnish scanty pasture for goats and camels.

The acacias, of which there are about 450 species, belong to the family *Leguminosae* and the sub-family *Mimosaceae*. The name comes from the Greek *akis*, meaning “thorn.” The false acacia, or American locust, is *Robinia pseudacacia*; it belongs to a different section of the same family (*see* Locust Tree).

ACADEMY, FRENCH. It is the day of the annual meeting of the French Academy, and the members file ceremoniously into their hall in Paris to occupy the arm-chairs of the Forty Immortals. They are the greatest living masters of French literature, and election to their body is considered the highest honor that can be bestowed on a French writer.

One of the chairs is vacant, for its occupant in the the past year has been removed by the hand of death. Presently one of the academicians arises and proposes a candidate. The works of the candidate are known to all; he has paid the obligatory visits to each of the members, and the necessary majority vote in his favor has been given. His sponsor wittily—sometimes rather sharply—characterizes him and his work, and the candidate responds good-humoredly, praising especially the deceased member to whose seat he has

been chosen. So the circle of the Immortals is once more made complete.

The French Academy was first founded by Cardinal Richelieu in 1635, and it still serves as a supreme court in all matters relating to the French language and literary style. The award of one of its 23 prizes to a French literary work is the supreme recognition of excellence. With four similar organizations—those for Inscriptions, Science, Fine Arts, and Moral and Political Sciences—the Academy constitutes the Institute of France.

Napoleon Bonaparte valued his membership in this organization so highly that he put after his name in his proclamations as General-in-Chief the words, “member of the Institute”—“so as to be sure to be understood,” said he, “even by the drummer boys.”

The original “academy” was founded by the philosopher Plato in ancient Athens, and was so called from the name of the grove *Academia* where he was accustomed to walk and talk with his disciples. The word came to mean an association for promoting literature, philosophy, science, or art, and many such organizations flourished in Italy in the days of the Renaissance. The most famous academy today is the French Academy described above. But there is also a British Academy for the promotion of historical and philosophical studies; the Royal Academy (British) for painting, sculpture, and architecture; the American Academy of arts and letters, with membership limited to fifty, etc.

The word academy is also used in the United States, Canada, and Great Britain as a name for schools for boys and girls similar to high schools. Most of these academies were founded before the present system of high schools arose, and were often fostered by churches or religious societies.

ACADIA (*â-câ'dî-â*). On Sept. 5, 1755, a group of some 400 men—French settlers in that district of the New World which we call Nova Scotia and which they named *Acadie*—were assembled in the church of Grand Pré, on an arm of the Bay of Fundy. Forty-two years before, France had ceded Acadia to Great Britain; but the inhabitants had clung to their French speech and sympathies, and in the recent “King George’s War” some of them had even taken up arms with their neighbors of French Canada. Now they were assembled to hear “his majesty’s intentions” with reference to them.

Briefly those “intentions” included the deportation of the male Acadians who refused to take an unconditional oath of allegiance to the British sovereign. Some 6,000—men, women, and children—were thus expelled and settled in the English colonies, from Massachusetts to Georgia. The story of Longfellow’s poem ‘Evangeline’ deals with the dispersal of these Acadians and the subsequent search of the maiden Evangeline for the lover from whom she had been separated on their marriage-day.

Acadia was settled by the French in 1604, but the English claimed the region on the ground of John Cabot’s discovery in 1497. The French Acadians now form one-tenth of the population of Nova Scotia.

BOOKKEEPING *Made EASY*—Some SIMPLE METHODS

ACCOUNTS. Spending money wisely is something more than opening your purse, and saving it is a more thoughtful thing than just keeping your purse closed. For thrift and saving, housekeeping, big business and little business, you must know where your money comes from and where it goes and

what for, and know too that there is a balance—that more comes in than goes out. To really know this in an accurate way, you must keep accounts—must understand “bookkeeping,” to use an old word that to most people seems to mean something very complicated and hard.



If a cash account is kept on opposite pages, the word *Cash* is written at the top of each page. On the left-hand page under the word *Received*, or under the abbreviation *Dr. (debit)*, are written the sums of money received as cash, or in the form of checks, drafts, money orders, etc. On the right-hand

page under the word *Paid*, or under the abbreviation *Cr. (credit)*, are written all sums of money paid out.

Figure 1 is a month's cash account kept by the treasurer of a school athletic association.

If you add the sum of money on hand (called the *balance on hand*) to that paid out, the total for the two

(Year)		RECEIVED			(Year)		PAID		
Mar.	1	From sale of season tickets	\$22	50	Mar.	2	K. Ryder & Co. for printing	\$ 2	20
"	2	From Mr. Whitney as gift	5	00	"	3	Telephone charge		30
"	15	From proceeds of dance	7	20	"	16	A. S. Spaulding for baseball and bats	7	40
"	17	Gate receipts of game	12	20	"	28	B. & M. for transportation	12	00
							Balance on hand	25	00
		Total	\$46	90			Total	\$46	90

Fig. 1. Cash Account, School Athletic Association.

But simple accounting is not difficult. The drawing of lines to inclose simple written entries of expenses and receipts is just an aid in the picture which every person—child or adult—should make of the things he does with his money.

The simpler methods are so plain and helpful that they can be mastered with less difficulty than most children's card games. Adding a second or third book or page to which the entries are made in a different form is simply adding another player, or rather an umpire, who keeps us playing the game correctly and decides doubtful points for us. Let us start the game of “Penny, penny, who's got the penny?” in its simplest form.

The leading forms of accounts are (1) an account of money received and spent, called a *cash account*; (2) an account of *indebtedness*, where money is owed by one person or firm to another.

How to Keep a Cash Account

A *cash account* may be kept on the opposite pages of a book as shown above; or it may be kept on one page containing double columns (see page 6).

columns in a cash account should be the same. If the totals are different there has been an item omitted, or some other mistake made.

Writing in the totals in an account is called *balancing* it. A cash account may be balanced daily or weekly, or at any other stated time.

The Use of the Ledger

In keeping an account of *indebtedness*, a book is used called a *ledger*. The name of the person owing money is written with his or her address on the lines above the account. At the left, on the *debit* side of the account, are written the items for which the person is in debt. At the right, on the *credit* side of the account, are written all sums of money he has paid and the value of goods or service for which he should receive credit.

The account in Figure 4 shows that Mrs. George L. Parker, of 28 Winter Hill Avenue, during the month of November bought from the firm keeping the account goods costing her \$29.00; and that she had returned silk for which she was credited \$5.00, and that she had paid on the bill \$24.00 in cash.

Figure 2 is the same account with the items all entered as they occurred on a single page containing one column labeled *Dr.* for cash received, and one column labeled *Cr.* for cash paid out.

day book, or the record is kept on *sales slips*. These items are transferred to a *ledger* in the form of a book, or to a set of ledger cards.

For example, a man by the name of David Grant,

(Year)			Dr.		Cr.	
Mar.	1	Received from sale of season tickets	\$22	50		
"	2	Received as gift from Mr. Whitney	5	00		
"	2	Paid R. Ryder & Co. for printing			\$ 2	20
"	3	Paid telephone charge				30
"	15	Received from proceeds of dance	7	20		
"	16	Paid A. S. Spaulding for baseball and bats			7	40
"	17	Gate receipts from game	12	20		
"	28	B. & M. for transportation			12	00
		Balance on hand			25	00
			\$46	90	\$46	90

Fig. 2. Cash Account, School Athletic Association.

Figure 3 shows a household account similar in form to that given first for the athletic association. The only difference is, that in place of the word *received*, the abbreviation *Dr.* is used, and in place of *paid*, *Cr.* Find the balance on hand.

who keeps a country grocery where elaborate accounts are not necessary, would enter such transactions as the following in a *day book*:

David Grant sells A. A. Evans, April 2, 1 bbl. St. Louis flour at \$14.00, 3 lb. currants at 30c.

Dr.					Cr.				
(Year)		CASH			(Year)		CASH		
Aug.	1	Balance brought forward	\$ 17	50	Aug.	1	August rent	\$30	00
"	1	Monthly allowance	100	00	"	1	Henshaw dairy for milk	5	06
					"	1	Wordman for groceries	31	61
					"	7	Porters for meat	20	84
					"	8	N. E. Telephone Company	1	80
					"	15	R. C. Filmore for eggs	3	88
					"	23	Gas Company	2	88
					"	28	Electric Light Company	3	30
							Balance on hand		
		Total					Total		

Fig. 3. Household Cash Account.

MRS. GEORGE L. PARKER
28 Winter Hill Ave.

Dr.					Cr.				
Jan.	1	1 Blanket	\$ 9	75	Jan.	9	4 Yd. Silk @ 1.25	\$ 5	00
"	8	2 Pr. Gloves @ 1.50	3	00	Feb.	3	Cash	24	00
"	8	4 Yd. Silk @ 1.25	5	00					
"	15	1 Waist	7	75					
"	18	10 Yds. Lace @ .35	3	50					
			\$29	00				\$29	00

Fig. 4. An Account of Indebtedness.

The accounts kept by business men depend upon the nature of their business. If the business is buying and selling on a small scale, the transactions are usually first written, as they occur, in a book called a

April 8, 2 lb. Rio coffee at 50c, 3 lb. Smyrna figs at 40c.
April 20, David Grant pays on account \$5.00.
April 30, David Grant sells A. A. Evans 5 lb. Vermont butter at 62c, and A. A. Evans brings David Grant ½ cord wood at \$8.00 per cord.

He would then transfer these items to a *ledger* in the form shown in Figure 5. Find the balance due on this account.

Double Entry Bookkeeping

When the business is more complicated, such as that conducted by a big wholesale house or by a factory, the accounts are much more elaborate. All transactions are recorded in at least two accounts, so that they occur on the *debit* side of one account and on the

keeping systems for great businesses, and the inspection of books and preparation of special financial reports for their clients. The profession is one which pays well, but it requires a good head for figures, accuracy, and thorough training. A good high school education is a minimum basis for preparation.

ACETYLENE (*a-sět'y-lēn*). A great excursion steamer with its load of merry-makers has suddenly overturned at its dock. The despairing cries of hundreds

A. A. EVANS

DR.				CR.			
April	2	1 bbl. St. Louis flour	\$14 00	April	20	Cash	\$5 00
		3 lb. currants @ .30	90	"	30	½ cord wood @ 8.00	4 00
"	8	2 lb. Rio coffee @ .50	1 00				
		3 lb. Smyrna figs @ .40	1 20				
"	30	5 lb. Vermont butter @ .62	3 10	May	1	Balance	

Fig. 5. A Ledger Account.

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Hours	Wages per hour	Over- time	Amount
James Richards	8	7½	7½	8	8	4		\$1.25	1	
Fred Hall	7¾	8	7½	7¾	8	3½		1.15		
William Holmes	8	8	8	8	8	4		1.15	1½	
George Smith	8	8	7¾	8	7½	3¾		1.00		
Arthur Dodge	7½	7	8	8	7½	4		.90		
William Jackson	8	7	7½	7¾	7¾	4		.90		
John Woods	8	7½	8	8	8	3½		.75		
Total										

Fig. 6. Carpenter's Time Sheet.

credit side of another. Such a system of keeping accounts or books is called *double entry* in distinction from single entry, where each item occurs on only one side of an account. This more elaborate form in bookkeeping enables a business house to check up the work more carefully.

A common record kept by a business man employing labor is the *time sheet*, such as the carpenter's time sheet shown below. From this record pay-rolls are made out. Find the missing items in the time sheet in Figure 6 which it is necessary to know before making out the pay-roll. Reckon the wages for over-time as one and a half times regular pay.

The Profession of Accountant

Just as a mechanical engineer represents a higher stage than a mechanic, so an expert accountant is more highly trained than a bookkeeper. Accountancy today has become a profession and courses in it are given in the universities. In many states examinations are given for those who wish to attain the title of C. P. A. (certified public accountant).

The work of such men includes the public audit of books required by law, the organization of book-

imprisoned within the steel hull mingle with the shrieks of the drowning. How can the survivors be rescued? Long before the riveted steel plates of the hull can be cut through with drills or cold chisels, all these men, women, and children will have been suffocated or drowned.

Suddenly nearby workmen appear rapidly bringing an oxyacetylene torch and the necessary steel containers. They turn a fine jet of brilliant greenish flame on the steel hull, amid a shower of sparks. Under the intense heat (3500° F. or more) the steel melts like wax. With the rapidity of shears cutting through pasteboard, the oxyacetylene flame cuts a great opening in the steel hull, through which the prisoners climb to safety.

Of equal importance with the use of the oxyacetylene torch for cutting steel plates and bars and wrecking steel structures is its use in welding metals. Street-car rails by means of it can be fused and welded into a single piece where they lie, so intense is the heat. It is also used for a thousand purposes in the manufacture or repair of machinery and other metal manufactures.

The oxyacetylene torch is only one of the many applications of this wonderful gas, acetylene. All over the world in the channels of navigation are thousands of acetylene-lighted buoys, marking the

CUTTING STEEL BEAMS WITH A
BREATH OF FLAME



This illustration shows a workman cutting a steel beam in two by the use of acetylene and oxygen. The two gases are sent through the blowpipe which he holds in his hand. In order to protect his eyes from the intense light and flying sparks, he wears big goggles.

course for ships, and many of these are provided with apparatus for manufacturing their gas automatically for 15 months without attention. There are 360 such buoys marking the channel of the Panama Canal alone. Also, in hundreds of mines in the United States, miners are lighted at their work by acetylene lamps fixed to their caps,

which give more than 20 times as much light as the old oil lamps formerly used. Thousands of homes and public buildings, especially in the rural districts of this country, are lighted by acetylene, and it is generally used for bicycle and motorboat headlights, and until recently for automobile lights as well.

Acetylene (C_2H_2) is usually made by the action of water on calcium carbide. This is a hard grayish slaglike mass (CaC_2), which is prepared by fusing lime and hard coal in the electric furnace. The manufacture of calcium carbide is largely carried on at Niagara Falls, on account of the cheap electric current there. The gas becomes liquid under high pressures, but is then highly explosive. It is usually transported, therefore, by dissolving it in a colorless liquid known as *acetone*, which absorbs 25 times its own volume of acetylene at atmospheric pressure, and proportionately more at higher pressures. Cylinders containing "dissolved acetylene," as it is called, are now obtainable almost anywhere in the United States.

ACHILLES (*ă-kīl'ēz*). Of all the Greeks who fought in the war about Troy, the bravest was Achilles, son of the king of the Myrmidons. His mother, the sea-goddess Thetis, was warned that her son was doomed to an early death, and had sought to ward off this fate by dipping him as a babe in the dark waters of the River Styx, which flows through the underworld, so that no weapon could wound him. The centaur Chiron taught him the art of war, as well as music and medicine. To prevent him from going to the Trojan War, his goddess mother dressed him as a girl and hid him among the maidens at the court of the king of Scyros (*sī'rōs*).

Thither came Odysseus (Ulysses), the wisest of the Greeks, disguised as a peddler. When he had

spread his wares before the laughing chattering girls, he suddenly sounded an alarm of war. The frightened girls ran screaming away, but the disguised Achilles betrayed himself by seizing a sword and spear from the peddler's stock. So, yielding to his destiny, the young hero joined his countrymen in the great conflict.

Achilles went to war with 50 ships and became renowned as the greatest warrior of all the Greek hosts. During the first nine years of the struggle he sacked 23 cities around Troy. Then he quarreled with Agamemnon, the leader of the Greeks, over a maid Briseis, whom he loved. When she was taken from him, he sulked in his tent, refusing to fight, and the Greeks were hard pressed. At last his friend Patroclus, wearing the armor of Achilles, drove the enemy before him, but was himself slain by Hector, the leader of the Trojans. Enraged at the death of his friend, Achilles went forth again to battle, equipped with new armor which his goddess mother prevailed upon Hephaestus, the god of metal working, to make. Achilles drove the Trojans within their mighty walls and in single combat killed Hector, whom he dragged three times around the walls at the tail of his chariot.

Here ends the account in the 'Iliad', which deals only with "the wrath of Achilles"; but the story is taken up by other writers. These tell how Achilles was slain some time later while driving the Trojans back to the city gates. The god Apollo, it is said, angered by the death of Hector, guided the arrow to the one part of Achilles' body that was vulnerable—the tendon of the heel, by which his mother had held him when she dipped him into the River Styx. Thus it is that this part of our bodies is still called "the tendon of Achilles."

ACIDS AND ALKALIES. Like human beings, the chemical elements of which the world and everything in it are composed can do things in combination which they cannot do separately. Indeed the nature of a chemical compound is often entirely different from that of any of the elements which enter into it. Thus, the flame-sustaining oxygen enters into partnership with the inflammable gas hydrogen and becomes the fire-extinguishing liquid, water. In the same way the highly poisonous gas chlorine combines with the metal sodium, to form an important ingredient of human food—common salt. So fond of team work are most elements that we meet them more frequently in compounds than free; some, in fact, are never found in nature uncombined. (*See Chemistry.*)

Among the thousands and thousands of chemical partnerships or compounds, there are three kinds of special importance. These are *acids*, *bases*, and *salts* (*see Salt*). They either enter into or have played a part in the production of almost everything that we eat, wear, touch, or use.

Acids and bases are chemically the opposites of each other. Hydrogen is always one of the partners

(Continued on page 10)

The Shield of Achilles



WHEN the grievous tidings were borne to Achilles, that Patroclus, clad in Achilles' armor, was slain, he poured dust over his head and tore his hair in anguish. His mother Thetis, the sea-goddess, heard from afar her son's lamentation and sped to his side.

"My child, why weepest thou? What sorrow hath come to thy heart?"

Achilles made answer: "My dear comrade is dead; Patroclus, whom I honored above all others as though he were my very self. My soul biddeth me also live no longer if Hector be not smitten by my spear and yield his life for the slaughter of Patroclus."

After mingling her tears with her son's, Thetis, the silver-footed goddess, sped straight to Olympus, the abode of the gods, to the forge of Hephaestus. In his youth she had befriended the lame god and now he was eager to help her. She told him of her son's trouble, and asked Hephaestus to make for Achilles, new armor such as never yet was borne by man.

The divine smith set to work and made a breastplate, and a great helmet ridged with gold, and also greaves to protect the hero's thighs. Most wonderful of all was the shield, whereon Hephaestus wrought great wonders of metal in bronze, gold, tin, and silver wire. There he fashioned cunningly the sea, the

earth, the sky and all its stars, the sun, and the moon. There were images of two cities, one at peace and one at war. In the peaceful city was a wedding and happy girls were singing. In the city at war were men defending it, who stood on its walls, while by a stream hid warriors, to spring on the cattle and herdsmen of their enemies as they came to drink.

In another part of the shield was pictured a field with plowmen at work, while in still another the harvest was being reaped. He also pictured a vineyard with men and maidens going down a path carrying baskets of grapes upon their heads, while in their midst a boy played upon a golden harp, singing pleasantly. Hephaestus also represented a dance of maids and men, most delicately wrought. From the silver belts of the men hung daggers of gold, and fair wreaths crowned the heads of the maids. Encircling the whole shield was an ocean that flowed around it like a great river.

Thetis received gladly these god-made arms that no mortal could pierce, and brought and laid them at the feet of her son.

Terrible as a god, his glittering armor blinding the eyes of the Trojans, his stature and strength filling their hearts with fear and trembling, Achilles led forth his men to battle, to take vengeance for the death of Patroclus.

—Retold from Homer's *'Iliad'*, Book xviii.



that unite to make an acid, and when an acid is brought into contact with a base it reorganizes to form a new partnership called a salt, exchanging its hydrogen for the metal of the base. A base is a compound of a metal or a metallic group of elements with oxygen and hydrogen. When the metal of a base takes the place of the hydrogen of an acid, this displaced hydrogen unites with the oxygen and hydrogen of the base to form water.

Many acids have the sharp sour taste which we call acid. Many of them also turn certain vegetable substances red, including one known as litmus, which is used to make a test paper called litmus paper (*see* Litmus).

Hydrochloric acid is a partnership of chlorine and hydrogen; sulphuric acid, of sulphur, hydrogen, and oxygen; nitric acid, of nitrogen, hydrogen, and oxygen. Vinegar is sour because it contains acetic acid; grapes contain tartaric acid; oranges and lemons, citric acid; and apples, malic acid.

Of all the bases (so called because they are regarded as furnishing the stable end of the salt partnership), the most important are the group known as alkalies. *Alkali* is an Arabic word meaning "ashes." The most characteristic alkalies are caustic soda or sodium hydroxide, and caustic potash or potassium hydroxide, which were first made from ashes. Alkalies have a bitter soapy taste and turn litmus paper blue.

How to Make Chemicals Talk

Bring the alkali caustic soda (which is a partnership between sodium, hydrogen, and oxygen) into contact with hydrochloric acid, and the old partnerships will be dissolved and two new ones formed, namely, sodium chloride, or common table salt, and water. Do you want to know how the new partnerships stand as acids or alkalies? Ask them; you can always ask a chemical substance what it is if you know how. Get a strip of litmus paper and put a drop of the liquid on it. Vinegar, besides tasting sour, will vote red on the litmus ballot, thus declaring, "I contain an acid." Limewater, besides tasting soapy and bitter, will vote blue, proclaiming, "I am alkaline." Sodium chloride or common salt solution will not change the color of either red or blue litmus paper, thus announcing itself as neutral. There are salts, however, in which the acid or alkaline end of the partnership predominates and many of these will show their preferences by their reaction to litmus.

Just because of their readiness to break up and become something else, acids and alkalies are of almost incalculable importance. They enter into our bodily processes; for instance, our blood is alkaline and our gastric juices acid, and any disturbance in the normal alkalinity or acidity of either affects our health.

Acids and Alkalies as "Engineers" and "Explorers"

This adventurous activity of acids and alkalies, moreover, makes them the engineers and explorers, so to speak, of our industrial processes. The paper on which this book is printed was made from wood pulp by the aid of sulphuric acid and caustic soda;

the pictures which illustrate it were printed from metal plates etched with nitric and hydrochloric acids. Architects make their blue-prints on paper which is treated with a salt of ferricyanic acid. Silica combines with lime and the alkali salts, potash and soda, to make glass; table glassware is etched with hydrofluoric acid. Soap is produced by the reaction between an alkali and a fatty acid. Baking powder "raises" dough because the reaction between its acid and its alkaline ingredients liberates the gas carbon dioxide. Acetic acid is used in the production of printed fabrics; boric acid and other acids in medicine. Soda enters into the tanning of leathers and the manufacture of dyes, washing powders, and bleaches. And these are only a few of the thousands of roles that acids and alkalies play in our lives.

The alkali salts, potash and soda, are pioneers in a double sense, for the shortage of the former about 150 years ago and the effort to manufacture the latter as a substitute largely started the activity which has resulted in the vast chemical industries of today. Potash salts were originally obtained by boiling the ashes of land plants in a pot, hence the name. In the 18th century the destruction of forests had limited the supply of potash salts and threatened the already important industries of dyeing and soap- and glass-making. It was known even then that soda could be used as a substitute for potash in some cases, but the only source of soda salts then known was the ashes of sea plants, and the supply was very limited. The Paris Academy therefore offered in 1775 a large money prize for a method of producing soda from common salt. The problem was solved and, directly or indirectly, the soda-manufacturing industry and the knowledge gained in it have been responsible for a large share of the achievement of modern industrial chemistry.

Certain substances share alkaline properties, although they are not strictly alkalies. Among these are the *alkaloids*, organic (vegetable) substances which may unite with acids to form salts. Some of the alkaloids, though highly poisonous, have valuable medicinal properties. Among the most important alkaloids are caffeine, found in coffee and tea; nicotine, in tobacco; morphine, in opium (which comes from poppy juice); quinine, in Peruvian bark; cocaine, in coca leaves; atropine, in deadly nightshade, etc.

Calcium, magnesium, and certain other substances are called *alkaline earth metals*, because some of their compounds have some alkaline properties.

ACONCAGUA (*ä-kon-kä'gwä*). The loftiest mountain in South America, according to most authorities, is the extinct volcano of this name in the southern Andes, on the boundary line between Argentine and Chile. Its height is 22,860 feet, or over 2,500 feet higher than Mt. McKinley, the highest summit in North America. There is also a river and province of this same name in Chile.

ACROPOLIS. Just as Athens is the center of interest in ancient Greece, so the Acropolis interests us most in Athens. In the long long ago the whole of Athens was confined to this single hill whose top the early inhabitants leveled and fortified against armies

from the surrounding plain. The Acropolis was defended by the Athenians for the last time in the second Persian War, when certain citizens fortified it with stakes and beams. The oracle at Delphi had promised safety in a "wooden wall" and not everyone believed with Themistocles that this oracle pointed to abandonment of the city to the intruder and reliance upon the "wooden wall" of the Athenian fleet. Some of the old statues, blackened by fire, remained after the retreat of the Persians, and Athena's sacred olive sprang up again from the roots.

The ascent to the Acropolis is made from the *Agora* or old-time market place. You go up a series of steps and through the *Propylaea* or gateway. This has a picture gallery on one side and a little temple of the Wingless Victory on the other. After going through the gateway you come out upon a marble terrace where the little Athenian girls used to dance dressed up like bears in honor of the goddess Artemis. Beyond that is the precinct where Phidias' great bronze statue of Athena stood. To the right is the Parthenon, and to the left the Erechtheum.

THE GLORIOUS ACROPOLIS IN THE DAYS OF PERICLES



This picture shows how the Acropolis looked in the time of Pericles. The temple and treasure house of Athena, the Parthenon, stands on the top of the hill at the right. It was not only the most beautiful temple in all Greece, but even in ruins, as it stands today, it is the world's most famous piece of architecture. It was approached by the winding road which you see in the foreground. The building in the center of the picture, with its six rows of pillars, is the Propylaea. Through this gateway the people passed to reach the temples. On the left of the Propylaea is the great statue of Athena. It was made of the swords and shields taken from the Persians at Marathon and was so tall that it could be seen by the Greek sailors far out at sea. Inside the Parthenon was another colossal statue of Athena, all of gold and ivory.

When the Acropolis was no longer needed as a fortification, Pericles made it a shrine of Athena, the patron goddess of Athens. The great sculptor Phidias planned the new Acropolis and made the principal statues, and the most famous sculptors, artists, and builders all had their part in making it beautiful. The hill rose several hundred feet above the surrounding plain, and when Phidias set his 36-foot bronze statue of Athena upon its top, sailors could see the shining crest of her helmet and tip of her spear as soon as they rounded the point of Sunium, some 15 miles away. Her treasure-house, the *Parthenon*,—so called from the Greek word for maiden, since Athena was preëminently the maiden goddess—was the most beautiful temple in all Greece. Erechtheus, one of the mythical kings of Athens, shared the honors with Athena, and his temple, the *Erechtheum*, was also very beautiful. Its famous little "porch of the maidens" still looks very much as it used to, although one of the supporting maidens has been carried to London and its place taken by a cast.

Of all the buildings which the genius of man has produced, the Parthenon was the most nearly perfect. It was built of Pentelic marble, with Doric columns all around it, the most beautifully proportioned that have ever been hewn. It was 228 feet long, 101 feet broad, and 65 feet high.

There were three sets of surpassingly beautiful sculptures. First there was the sculpture of the two "pediments" or triangular gables at the ends of the building. The eastern pediment represented the birth of Athena, the western or back pediment the struggle between Athena and Poseidon for the guardianship of Athens. Then there were the "metopes" (squares which in a wooden temple would be the ends of beams), 92 in all, and these were carved in relief each with some separate mythical hand-to-hand struggle—gods against giants, Lapithae against Centaurs, Greeks against Amazons, Greeks against Trojans, and so forth. The third set of sculpture was the "frieze" around the top of the *cella* or chamber wall inside the colonnade. This represented the Panathenaic

procession which took place every year for the ceremonial purpose of giving Athena a new saffron gown. The frieze was 39 feet above you, and as you caught glimpses of it between the pillars it seemed to be slowly advancing.

In the shrine beyond the cella was the famous ivory-and-gold statue of Athena Parthenos, which reached to the ceiling and had \$750,000 worth of refined gold upon the raiment. This statue was the work of Phidias and was very beautiful as well as costly. Everything about the temple was most exquisitely proportioned, so the architects today still study its ruins with loving professional interest.

When the Greek traveler Pausanias visited the Acropolis in the 2d century A.D.—seven centuries after Pericles—it was filled with statues and monuments, some old, some of them as late as the Roman emperor Hadrian. Now there is little left except the architecture. The sculpture suffered terribly by theft and otherwise in the Middle Ages. The greatest damage to the building came in 1685, when the Turks used the Parthenon as a powder magazine, and it exploded. Many of the sculptured marbles that survive to our own day were taken to London for safe-keeping in 1825.

Many another ancient city besides Athens had its Acropolis, for the word means the highest part or citadel of a city. In fact some writers say that it was the presence of these flat topped hills in the Greek plains that made the development there of a high civilization possible at so early a date.

ADAMS, CHARLES FRANCIS (1807-1886). "None of our generals in the field, not Grant himself, did us better or more trying service than Charles Francis Adams in his forlorn outpost in London."

These words of James Russell Lowell, himself at a later date a distinguished occupant of the same post, embody the sober judgment of history on the American minister to Great Britain in the trying days of the Civil War. Patriotism, high ideals of public service, sturdy independence of character, and sound intelligence were parts of Adams' puritan inheritance; for he was a member of that famous Massachusetts family which for more than three generations played a leading part in American history.

The son of John Quincy Adams and grandson of John Adams, he was born in Boston, graduated from Harvard College (in 1825), and studied law under Daniel Webster. He was for five years a member of the Massachusetts legislature, and in 1848 was the Free Soil candidate for vice-president. When the Republican party was formed ten years later, he joined it and was elected to Congress. President Lincoln then appointed him minister to England, a position which he filled with such great ability from 1861 to 1868.

Mr. Adams found the great body of upper-class Englishmen hostile or indifferent to the Federal government in its struggle with the South. The British government had early granted equal rights as a "belligerent" to the Confederacy, and the Prime Minister and Foreign Secretary only awaited a

favorable occasion to recognize its independence. Our blockade of the Southern ports forced the Lancashire cotton mills to shut down for lack of raw material, and the mill owners demanded loudly that Great Britain raise the blockade. The most difficult question of all arose from the laxity of the British government in permitting the famous *Alabama* cruiser, built for the Confederacy in England, to escape to the high seas and begin its career of destruction.

Probably no diplomatic representative of any country ever had more difficult questions than these to handle. It must be remembered also that this was in the days before submarine cables and wireless, and the minister was forced to act largely on his own judgment. But Mr. Adams showed ability and tact of a high order in asserting our rights, and the place which he thus won for himself is second only to that of Franklin in the history of American diplomacy.

Mr. Adams' last public service was as a member of the Geneva arbitration tribunal (1871-72), which fixed the amount of damages Great Britain paid for permitting the *Alabama* to escape.

Henry Adams (1838-1918), whose brilliant book entitled "The Education of Henry Adams" was published in 1918, was a distinguished son of Charles Francis Adams. He was at one time professor of history in Harvard University and was the author of numerous historical works, including a notable "History of the United States from 1801 to 1817" (9 vols.). His brother, Charles Francis Jr. (1835-1915), was also eminent as a soldier in the Civil War, railroad president, and historian. Brooks Adams (1848-) has written on economic and social topics.

ADAMS, JOHN (1735-1826). At a time when American patriots had as yet scarcely learned to utter the word "independence," strong-headed and stout-hearted John Adams, as delegate from Massachusetts to the Continental Congress, was urging separation from the mother country, and doing it so boldly as to cause him to be shunned by his fellow delegates in the streets of Philadelphia.

He was the first member of this notable family to rise to fame. Born in what is now the town of Quincy, Mass., he was graduated from Harvard College in 1755 and three years later began to practice law. After a few years he married Abigail Smith, a neighboring minister's daughter. His intimate letters to her and hers to him during the period which followed throw a flood of light on many Revolutionary events.

Foremost Champion of Independence

One of the most courageous things John Adams ever did was to undertake, in a time of great patriotic excitement, the defense of the British soldiers on trial for murder as a result of the so-called "Boston Massacre" (1770). Not merely did he procure the acquittal of all but two of them, but he so impressed his fellow townsmen of Boston with his courage, honesty, and patriotism that they forthwith elected him to the colonial legislature.

From the beginning of the struggle with the mother country, Adams was one of the staunchest upholders

of the rights of the colonies, both in his speeches and in writing for the press. He opposed the Stamp Act and was a member of the Massachusetts delegation to the Continental Congress from 1774 to 1778. When at last the members of the assembly were converted by events to his way of thinking as to separation, it fell to his lot to second, on June 7, 1776, the

Britain, a post which he held until his return to become the first vice-president of the United States.

Succeeds Washington as President

When political parties sprang up in Washington's administration, Adams and Alexander Hamilton became the recognized leaders of the Federalist party, in opposition to Jefferson and the Democratic-

AMERICA'S MOST ILLUSTRIOUS FAMILY



JOHN ADAMS

famous resolution of Richard Henry Lee, that "these colonies are, and of right ought to be, free and independent states."

John Adams was made a member, with Jefferson, of the committee appointed to draw up the Declaration of Independence, and in the debates which followed its introduction into the congress, he was its foremost champion. In this and other proceedings he gained the reputation of having the "clear-est head and firm-est heart of any man in Congress."

In 1778 Adams sailed for France, which had just signed a treaty of alliance with the revolted colonies, to take his place as one of the commissioners to that country. There he rendered new services to the American cause as notable as those rendered while in Congress. With John Jay and Benjamin Franklin, he concluded the preliminary treaty with Great Britain, in 1782, which recognized the independence of the United States and ended hostilities. He then became the first American minister to Great

Here are five most distinguished members of the famous Adams family,—John Adams; Abigail Adams his wife, to whose wise counsel he attributed his success; John Quincy Adams, their son; Charles Francis Adams, their grandson; and Samuel Adams, the organizer of the "Tea Party," who was a second cousin of John Adams.



JOHN QUINCY ADAMS

Republican party. Adams succeeded Washington as president in 1797, but owing to political mismanagement Jefferson was chosen vice-president with him.

In spite of Adams' great ability, patriotism, and integrity of character, he was never really popular, even with the Federalists. He was blunt, vain, and tactless, and the Jeffersonian Republicans charged him with wishing to confine power to "the rich, the well-born, and the able." He did not get along well with Alexan-



ABIGAIL ADAMS



SAMUEL ADAMS

CHARLES FRANCIS ADAMS

der Hamilton, the ablest leader of the Federalists, and as a result the party was hopelessly split during the whole of Adams' administration. Party passions grew ever higher, and there was increasing friction also with the rulers of Revolutionary France. As a result, the four years of Adams' presidency were one of the stormiest periods of our history.

For a moment only were factions stilled. This was in 1798, when the insolent demand of the French

Directors for money bribes led our envoy Charles C. Pinckney to use his famous phrase, "Millions for defense, but not one cent for tribute" (see X Y Z Affair). For a brief time war with France actually existed on the sea, and military preparations were energetically pushed. President Adams won great applause by his declaration, "I will never send another minister to France without assurance that he will be received, respected, and honored as becomes the representative of a great, free, powerful, and independent nation."

Friendly relations with France were soon restored, but the war taxations led to new complications at home. There was rioting in Pennsylvania, known as "Fries' Rebellion"; and the Federalists who were in power used the opportunity to press tyrannical laws known as the "Alien and Sedition laws." President Adams took no part in securing these statutes, but he shared in the unpopularity which they excited. One Vermont editor, for example, was fined \$1,000 and imprisoned four months for saying that Adams possessed "unbounded thirst for ridiculous pomp and for foolish adulation." The Virginia and Kentucky legislatures passed resolutions asking the other states to unite with them in declaring the objectionable laws "null and void." These resolutions proved important in giving rise to doctrines of "nullification" and "secession" which were later used by the South in the slavery controversy.

Defeated for Re-election

These Alien and Sedition laws were the result of the Federalists' distrust of the masses of the people. They contributed largely to the defeat of their party in the elections of 1800, as a result of which Adams and Pinckney received only 65 and 64 electoral votes, to 73 given for Jefferson and Burr, the Republican candidates. One of President Adams' last official acts was the appointment of John Marshall of Virginia as chief justice of the supreme court.

His failure of re-election was a bitter disappointment to Adams. He retired at the end of his single term to pass the last 25 years of his existence in private life. He refused petulantly to stay to see his successor inaugurated, and left for Massachusetts before daybreak on the morning of March 4, 1801. In spite of such childishness his fame has grown with the passing years, until now this second president of the United States appears as no unworthy figure in heroic times. John Adams died on July 4, 1826, on the 50th anniversary of the independence of the United States. Jefferson, with whom Adams had long been reconciled, died the same day; but Adams,

not knowing this, murmured as he died: "Thomas Jefferson still lives."

ADAMS, JOHN QUINCY (1767-1848). In a public address Mr. Adams once quoted some words from the Latin author Tacitus, which a lady in his audience translated as meaning "Equal to, not above duty." She added that a better translation would be the three words, *John Quincy Adams*.

Duty was the keynote of the younger Adams' whole life. We see it in the boy when at 10 years of age he wrote to his father: "I make but a poor figure at composition. My head is much too fickle, my thoughts are running after birds' eggs, play, and trifles till I get vexed with myself."

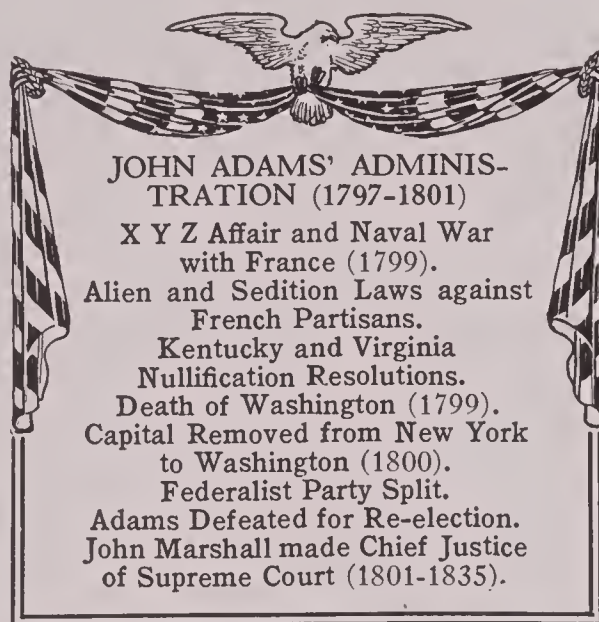
We see it again in the young man who turned his back on life at the court of St. James, in England—to which his father had just been appointed the first minister from the United States—and returned to America in order that he might obtain a degree at Harvard College; although he felt, "were I now

to go with my father, probably my immediate satisfaction might be greater than it will be in returning to America."

A Diplomat at Fifteen

At that time (1785) he had enjoyed life abroad for seven years. He was born at the old Adams home in Quincy, Mass. When 10 years old he had accompanied his father to Paris, where the elder Adams was American representative during the Revolutionary War, and for some time he was in school in Paris and Holland. At 15 he accompanied Francis Dana to Russia as private secretary, when that gentleman received the appointment—not recognized by Russia—as envoy to the court at St. Petersburg. We cannot wonder that he found the prospect of giving up this diplomatic life "somewhat discouraging for a youth of my ambition."

In his case sacrifice brought its reward, for, after having graduated from Harvard in 1788 and been admitted to the bar three years later, he was appointed by President Washington as minister at the Hague (Holland), when he was barely 27 years old. When John Adams became president the question of his son's diplomatic future became an embarrassing one, for both father and son possessed an old-fashioned puritanical sense of duty, and President Adams did not wish to be accused of favoritism. But Washington came to the rescue, and in a letter to President Adams urged that John Quincy Adams should be promoted to the place of minister at Berlin, because (as he said) "young Adams was the ablest person in the American diplomatic service."



This unquestioned ability and the fact that people knew he would always do his duty were the characteristics to which John Quincy Adams owed his long political career. Besides the diplomatic positions already mentioned, he served as minister to Russia, as United States senator and representative from Massachusetts, as secretary of state, and as president. And he held all of these positions in spite of the fact that personally he was one of the most unpopular men in the country—largely owing to his habit of always doing his duty and saying just what he thought.

Lack of Popularity at Home

His unpopularity was first shown when he was in the Senate during Jefferson's administration. Part of the hostility which he encountered was due to the anger which all Jeffersonian Republicans—and many Federalists—felt for his father, and part was due to his own ungracious manner; but most arose from the fact that, although he was a New Englander, he supported Jefferson's embargo policy and the Louisiana Purchase. On this account the Federalists turned against him and bitterly reviled him for deserting his party; and so he was opposed by both Federalists and Republicans at the same time. Any measure which he proposed was sure to be defeated. He was forced to get other senators to introduce his bills, because, as he remarked, "I knew that if I moved it, a spirit of jealousy would immediately be raised against doing anything."

He expected that his support of the embargo policy would end his political career—a most unpleasant prospect for him, for Adams was fond of political life. His expectations were agreeably disappointed, however, for the Democratic-Republican party took him up; and when President Monroe, in 1817, appointed him secretary of state, he seemed to be in line for the presidency, for both Madison and Monroe had stepped from the one office into the other.

Adams wished to obtain the presidency, not only for the honor of the office itself, but also because he felt that he was well fitted for it. Nevertheless, in 1824 he proudly refused to do anything to promote his election. It was a grievous disappointment to him that the election went to the House of Representatives owing to the fact that no one of the four candidates—Jackson, Adams, Crawford, and Clay—had secured a majority of the electors chosen by the people. Even then Adams made no effort to advance his own interests.

Elected President over Jackson

As Clay was not a candidate before the House (having been fourth on the list), his friends supported

Adams. This gave Adams the election, which very much angered the friends of General Jackson, who had received the largest number (though not a majority) of the electoral votes. When Adams appointed Clay to be secretary of state, Jackson's followers immediately brought a charge of "corrupt bargain," falsely declaring that Adams had promised Clay the position for his aid in the election.

The quarrels between the "Jackson men" (who became known as Democrats) and the "Adams men" (who became Whigs) were the most significant events of Adams' administration. The Democrats were strong enough in Congress to defeat any bill which Adams wished passed. For instance, in 1826 the President named two delegates to the Panama Congress, an international conference to discuss affairs of interest to the countries of North and South America. The Senate foolishly and violently debated the confirmation of the nominations until it was too late for our repre-

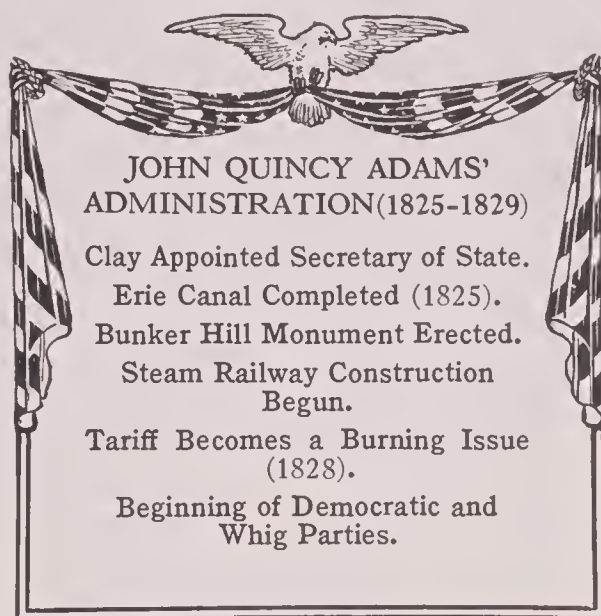
sentatives to reach Panama in time for the meeting. Two other events of importance during Adams' administration were the completion of the Erie Canal in 1825 and the laying of the corner-stone of Bunker Hill monument in the same year.

But Adams' administration was marked by few events of importance, and it is on the whole the most uninteresting period in his life. It was also the most disappointing to Adams himself, and we cannot help feeling sorry for him when he writes, at the close of his single term of the presidency, that "the sun of his political life sets in the deepest gloom."

Later Served in Congress

He was mistaken, however, in thinking that the "sun of his political life" was set. In 1830 he was elected to the national House of Representatives, and he continued to represent his district in that body until his death 18 years later. When some one suggested that it was rather "degrading" for him to thus step down, Adams replied: "No person could be degraded by serving the people as a representative in Congress. Nor, in my opinion, would an ex-president of the United States be degraded by serving as a selectman of his town, if elected thereto by the people." Far from being degraded, Adams spent in Congress the most brilliant and glorious years of his whole career, and earned in his old age by his courage and sturdy integrity a fame far above any that he had achieved before.

This arose from the fact that he organized and led in that House the opposition to slavery. For seven years he fought, in season and out, against the "gag



rule," which was designed to put an end to anti-slavery petitions in Congress. In the end the victory was won and the "right of petition" was preserved as one of the privileges of the people, no matter how unpopular their views.

The "Old Man Eloquent"

In a day when such orators as Webster, Clay, and Calhoun were in public life, Adams yet won for himself the title of "Old Man Eloquent." His claim to this was based on the information contained in his speeches and not to any charm of appearance or grace of voice or manner as an orator. He was short, fat, and bald; his voice was high, shrill, and liable to break—piercing enough to be heard, but not agreeable. In manner he was so restrained and cold that he was extremely unpopular in the House.

But if he was disliked and unkindly treated by others, he was in turn uncharitable to them. In his voluminous 'Diary' of 12 printed volumes, in which he records his feelings and doings, hardly a man in public life escapes condemnation. One author wrote that, "as one turns the leaves, he feels as though he were walking through a graveyard of slaughtered reputations, wherein not many headstones show a few words of measured commendation." This habit of harsh criticism cost Mr. Adams much, for it not only made him unpopular in life, but even today we find it hard to like the man. It should be said, however, that he applied the same tests of puritanical severity to his own character and acts that he applied to others. In all this he is a good example of the Adams family—upright, honest, and able far beyond the average of their associates, but with a fatal gift for tactless speech and unpopularity.

ADAMS, SAMUEL (1722-1803). In the midst of the troubles which led up to the American Revolution, Hutchinson, the Tory governor of Massachusetts, wrote to one of his friends: "If it were not for two or three Adamses, we should do well enough." No doubt it was "Sam" Adams, the busy thriftless politician of the Boston town meeting and radical writer for the newspapers, that the good governor had chiefly in mind in writing thus feelingly of this patriotic family.

A Father of the Revolution

Already in 1743, when he was given the degree A.M. by Harvard College, Samuel Adams had shown the dangerous character of his thoughts, for he had taken as the subject of his thesis this question: "Whether it be lawful to resist the Supreme Magistrate, if the Commonwealth cannot otherwise be preserved." More than 30 years before the armed revolt, his mind was already engaged with those questions which were involved in the struggle with the mother country. It is thus with good right that the historian Fiske says of him that "in the history of the American Revolution he is second only to Washington."

Samuel Adams was a second cousin of John Adams and all his life long was a resident of Boston. He had

little inclination for the business in which he engaged after graduating from college, and more and more devoted himself to public affairs. He was a leader in the meetings of the workingmen's "Caulkers Club" (from which perhaps comes our word "caucus"), in the town meetings in Faneuil Hall, and later in the Old State House where sat the Massachusetts colonial assembly of which for a score of years he was the clerk.

The Man who Started the "Tea-Party"

In 1764 he had become so influential that he was chosen to write Boston's protest against the proposed Stamp Act. As a member of the Massachusetts assembly, in public meetings, in writings in the newspapers, and as a member of the Continental Congress (1774-1781), he urged determined resistance to taxation of the colonies by Parliament, and early advocated independence. He was the organizer of the "Boston Tea Party," in 1773. He was not to be bought or silenced, and he rendered invaluable services not merely in arousing public opinion in his own community, but in linking up the movement there with that in other colonies, by means of committees of correspondence.

After the first battles of the Revolution, a price was set by General Gage on the heads of both "those formidable rebels" Samuel Adams and John Hancock. As a member of the Continental Congress, Samuel Adams signed the Declaration of Independence. And after the war was over he helped to frame the constitution of Massachusetts, and served one term as governor of his native state.

Samuel Adams, however, was a destructive rather than a constructive statesman. He opposed the Federal Constitution when it was first submitted to the states for ratification, on the ground that it gave too great powers to the central government and that it was undemocratic in some of its features. But later he was brought to support it in the Massachusetts convention, when amendments were proposed which would render the rights of the people more secure. He died at the age of 81, as poor as he had always lived.

ADDAMS, JANE (born 1860). "When I grow up I will have a large house, but it will not be built among the other large houses, but right in the midst of horrid little houses like these." This was the remark of Jane Addams, then a frail thoughtful little girl in Cedarville, Ill., when she went with her father one day into the poor district of the city. Before that she had always supposed that everyone lived in good and comfortable houses like her own.

She never forgot "the horrid little houses" and her desire to make people happier. When traveling in Europe after she had gone through Rockford College, she visited Toynbee Hall in London, the first of many "social settlements" where kind-hearted men and women voluntarily live in the city slums to aid and befriend the very poor. This suggested a way of carrying out her dream.

In 1889 with a friend, Miss Ellen Gates Starr, she moved into Hull House, an old mansion of early Chicago days, around which had grown up a crowded foreign quarter. Believing that "the things which make men alike are finer and better than the things that keep them apart," she put into this house the kind of books and pictures and furniture that she would wish to have in her own home, and in her

Today Hull House covers an entire city block and is the home of about 50 "residents"—most of them college men and women who pay their own expenses and give part or all of their time to the activities of the settlement and the neighborhood. Other teachers and helpers come in from outside. Only a very few receive any salary. The same homelike feeling still pervades the settlement, and Miss Addams' beautiful

HULL HOUSE AND THE WOMAN WHO CREATED IT



Here we have in one group a picture of Hull House in Chicago, taken from the corner of Halsted and Polk Streets, together with typical scenes illustrating the things that are done inside of it, and a portrait of the noble woman who founded it. As a neighbor of the poor people who live in this district, Miss Addams and her associates not only do everything for them that the best of neighbors would do, but treat them as if they were all members of the Hull House family. In the upper left-hand corner you see young students of electricity studying out how to wire a house. Just below them some modern Greeks are indulging in the sport which was so important a part of the life of the ancient Greeks—wrestling; while in the upper right-hand corner children are giving the play of Puss-in-Boots in the beautiful little theater at Hull House. Below them boys with a taste for art are learning to draw, as they do at the big Art Institute; and on Miss Addams' left is an Irish woman spinning, just as she used to do in the old country, making herself very useful and very happy.

gracious way invited her neighbors to come to see her. She helped those who were ill or in trouble; she started a day nursery where the little children could be properly fed and amused while their mothers were at work; and she organized clubs and classes of many kinds for the older boys and girls and the grown people. Poor, puzzled, friendless immigrants of 36 different nationalities were made to feel at home, and here in this atmosphere of true democracy they learned to be Americans in the best sense.

The Good Neighbor of Hull House

Hull House soon became the most famous of all American social settlements. It grew until before long it included a fine gymnasium, a well-equipped little theater, reading rooms, attractive club rooms, a coffee house, and a large hall for dancing and other entertainments. There was also equipment for teaching woodworking, weaving, basketry, domestic science, and other arts and handicrafts.

personality radiates throughout, extending the same welcome to the distinguished visitor and the poor laborer.

A Leader in Social Work

Similar settlement houses, largely modeled after Hull House, have been founded in all of our large cities. Many cultured men and women are glad to share their advantages in this way with their less fortunate neighbors, and at the same time, by living in contact with people of other conditions and nationalities, to broaden and extend their own knowledge and sympathies.

Jane Addams has long been known as one of the foremost citizens not only of Chicago but of the United States. No helpful task is too great or too small for her hand. She served at one time as municipal garbage inspector, at another time she was a member of the school board. She was influential in securing a Juvenile Court for Chicago, and child-

labor, factory, and tenement-house laws. Several universities have honored her with degrees and she is known throughout the world as a lecturer and writer on social problems. At the close of the World War she was chairman of the International Committee of Women for Permanent Peace.

Jane Addams' best-known writings are: 'Democracy and Social Ethics' (1902); 'Newer Ideals of Peace' (1907); 'The Spirit of Youth and the City Streets' (1909); 'Twenty Years at Hull House' (1910); 'A New Conscience and an Ancient Evil' (1911).

ADDITION. If a boy can keep a baseball score, there's no reason why he can't easily learn to add sums of any length, if he just keeps cool and is careful. And as for the use it will be to him, whether he is making change, or preparing a report of the money he has spent as treasurer of his baseball team, or figuring how much lumber he will need to make a boat-house, or doing any of a hundred things he will often want to do, he will have to use addition. What he needs to do is to practice and practice until he just can't make a mistake in adding.

Do It Quickly and Do It Right

Every boy and girl ought to know how to add rapidly and correctly. And they will be surprised to find how easy it really is to learn, if they only go at it the right way.

Mother and father or brother and sister can help any boy by giving him the exercises suggested below. He must not bring his work home for somebody else to do, or expect to learn addition through any one's effort but his own. No one would like to walk on crutches all their lives and your healthy brain does not need crutches any more than your healthy body. And the people one learns to lean on are not always there when you want them. If you have a newspaper route or do any selling you can hardly expect the teacher or somebody at home to be at your elbow every time you want to add up what is coming to you from a customer.

And as addition is simple in itself, don't let the idea that it is difficult get into your head for a minute. And don't let anything but addition get into your head when you are working at it. Keep your mind on it and you won't forget and have to begin all over so many times.

Here are some suggestions that are useful in gaining accuracy and speed in addition:

(1) Master the combinations with 1, 2, 3, 4, 5, 6, 7, 8, and 9 until you can give them without an instant's hesitation. These combinations, called the "forty-five fundamental facts," are the basis of all addition, for they give every possible combination of the digits.

(2) Write all figures in straight rows and columns.

(3) Use as few words as possible. In adding 6, 7, and 5 don't say "6 and 7 are 13 and 5 makes 18." Merely give the results, "13, 18."

(4) Cultivate the habit of adding steadily, but at the same time rapidly.

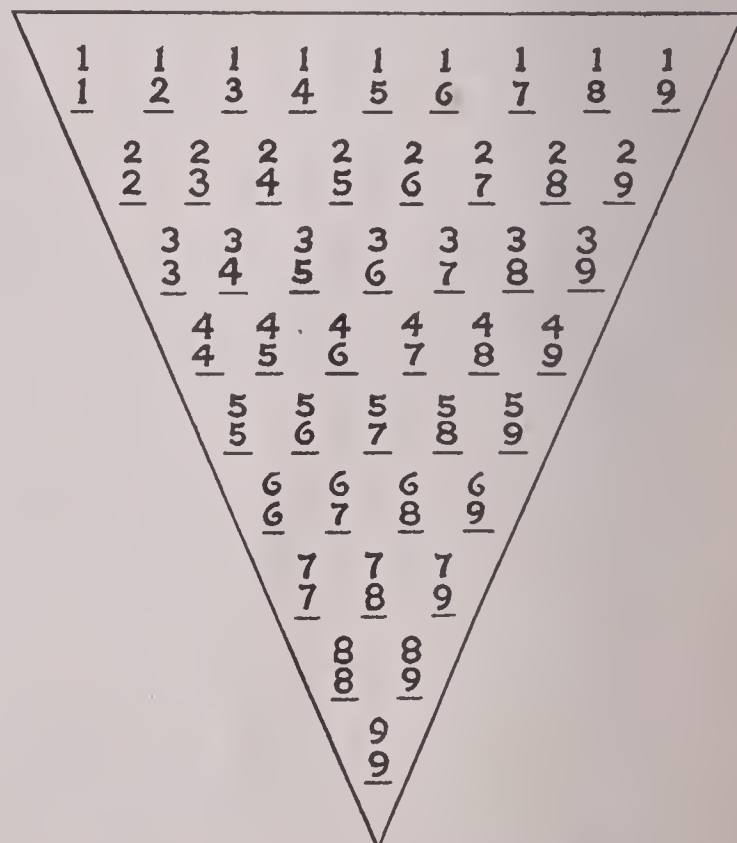
(5) Test all your answers.

The combinations spoken of as the "forty-five fundamental facts" are as follows:

1	2	2	3	3	3	4	4	4	4	5	5	5	5	5	6
1	1	2	1	2	3	1	2	3	4	1	2	3	4	5	1
2	3	4	4	5	6	5	6	7	8	6	7	8	9	10	7
6	6	6	6	6	7	7	7	7	7	7	7	7	8	8	8
2	3	4	5	6	1	2	3	4	5	6	7	1	2	3	4
8	9	10	11	12	8	9	10	11	12	13	14	9	10	11	12
8	8	8	8	8	8	9	9	9	9	9	9	9	9	9	9
3	4	5	6	7	8	1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	10	11	12	13	14	15	16	17	18	19

See How Quickly You Can Do This!

The accompanying chart will aid in mastering these "fundamental facts." Have someone point rapidly to first one and then another, chosen at random, and see if you can instantly give the answer.



Make a game of this and see how quickly you can learn to give instantly the sum of each of the above combinations as it is pointed to.

Next, to form the habit of adding steadily and rapidly, put down a column of figures in any order and practice naming the partial sums one after the other, as shown in the margin, until they can be given without hesitation and at a rapid rate.

9 51
6 42
5 36
7 31
9 24
8 15
7

Beginning at the bottom of the annexed column, we add: 7+8=15; 15+9=24, etc. Add rapidly, giving successive sums only: "15, 24, 31," etc.

(Continued on page 24)

Addition

Arithmetic just makes me sick,"

Cried our poor little Mary.

The figures never act the same,

They're always so contrary."

That night, when Mary fell asleep,

A dream so wondrous came,

That afterwards Arithmetic

Was never quite the same.

Mary's Dream

Quite suddenly a funny man

Was standing by her side,

"Arithmetic has made you sick;

Just take this pill," he cried.

He held out such a great big pill

She screamed out, "Never, never!"

But down it went and then, said he,

"You're just as well as ever."



And next he gave a whistle clear.
 The door flew open wide,
 And in a lot of figures rushed
 And stood there by his side.



"My name is Mr. Arithmetic"
 He said: "I came to-night
 To introduce these figures here
 And do it truly right."



"The first is Zero as you see,
 And then right down the line



Are One Two Three and Four Five Six

Then

Seven

Eight

and Nine



"Now here you see our cousin Plus,
 And all must understand
 That Plus is just another way
 Of saying little 'and.'"



Then Equal, too, I'll introduce;
She has another name.
It's 'Make', and both of them you see
Mean just the very same."



He clapped his hands and music came
From somewhere out of sight.
The figures marched in perfect time
Left, right-left, right-left,



Then Two and Three marched from the line
And Plus stepped in between.



When Equal took her place like this
A question could be seen.....



"Two plus three make what," they said.
Were waiting to find out."



Five took his place, for Three and Two
Make Five without a doubt.





Then marching to the music gay,
 New questions form in line;
 They showed in just a minute more
 That Seven And Two Make Nine.



And Four Plus Three Make Seven, too,



The figures form with care;
 Then quickly Five Plus Four Make Nine;



Just see them standing there.





And Five And One Make Six, of course;



And Three Plus One Make Four



And Five And Three Make Eight as well



And Oh, so many more.



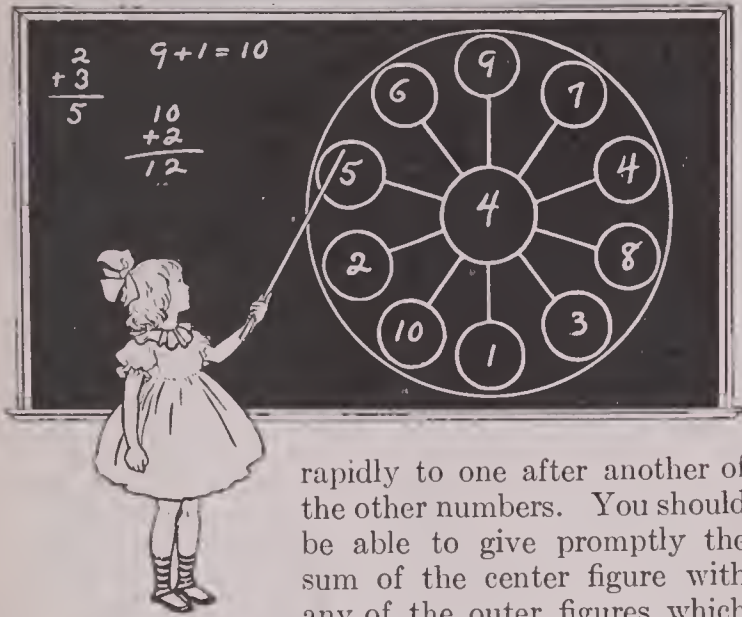
These figures are like Washington

And I will tell you why;

It really is exactly true

That figures never lie."

The accompanying diagram affords an excellent drill for rapid work in addition. Draw the diagram on a blackboard or large sheet of paper. Then let someone write a number in the center circle, and point



rapidly to one after another of the other numbers. You should be able to give promptly the sum of the center figure with any of the outer figures which the pointer indicates. Change the center figure often.

Is My Answer Right?

For computations in the business and scientific world, absolute accuracy is required; so it is necessary to have means of checking or testing the correctness of a sum. The means most commonly used is to *repeat* the addition. If the columns have been added from the bottom *up* in getting the sum, they are added *down* in testing its correctness. Or if added *down* at first, then in testing, the columns are added from the bottom *up*.

One way of simplifying the testing when columns are long is to write the partial sum for each column and then find the sum of these partial sums. A mistake in any one column can then be detected without re-adding all the columns.

In the accompanying example 52 is the sum of the first column, 55 of the second, etc. Note that the tens column is set over one place to the left and the hundreds two places, as compared with the units column.

Another means of checking an answer is to break the columns, and find the sum of each section, and then add these results. The sum of the first four numbers in the problem above is 2083, the sum of the lower four 2019. Since the sum of 2083 and 2019 is 4102, it proves that the first result is correct.

Try These Exercises in Addition

Here are some exercises in counting for mastering the fundamental facts.

Count into the twenties by 2's beginning with 1. Beginning with 2.

Count into the thirties by 3's beginning with 1. With 2. With 3.

Count into the forties by 4's beginning with 1. With 2. With 3. With 4.

Count into the fifties by 5's beginning with 1. With 2. With 3. With 4. With 5.

Following the plan suggested above, practice counting by 6's, by 7's, by 8's, by 9's.

Try these exercises for practice in adding with as few words as possible:

235	274	975	345	411	265
436	854	214	758	253	748
578	375	328	327	167	392
396	346	569	864	399	679

These are for practice in adding at a steady rate:

3	5	6	7	5	6	4	2	5	4	6	7	8	9
2	4	4	3	7	3	8	3	8	9	9	9	7	8
1	2	3	4	6	7	3	8	3	3	5	9	9	7
4	3	4	5	4	4	2	5	7	2	9	3	6	6
5	5	5	6	7	7	8	4	7	9	9	2	8	9
3	4	6	7	7	5	6	8	8	4	4	8	9	8
3	6	6	5	6	5	5	3	8	3	6	9	7	6
5	5	4	6	5	7	7	7	5	9	9	9	8	9
4	4	6	6	6	6	8	6	6	2	7	9	6	7
3	2	5	7	7	7	4	8	2	5	6	4	5	3
5	6	6	7	7	7	8	8	6	3	8	7	9	9
6	7	9	8	9	6	6	5	8	9	9	9	8	5

Here is an exercise for practice in adding and testing answers; it represents the sales of a department store for a week:

Days	Dry Goods	Boots and Shoes	Furniture	Kitchen Utensils	Groceries	Total
Monday.....	\$89.53	\$40.75	\$25.65	\$41.58	\$27.35	
Tuesday.....	91.40	19.60	80.75	38.15	21.17	
Wednesday...	53.35	39.10	63.48	52.19	33.41	
Thursday....	62.20	24.70	15.90	23.63	19.05	
Friday.....	21.14	20.50	31.80	18.77	15.46	
Saturday.....	93.27	61.90	26.50	25.54	54.93	
Total.....						

Copy and complete the above statement. Prove by adding the vertical (up and down) and horizontal (across the page) totals.

An important point to remember is that only *like* quantities can be added. To add cents to dollars, the cents are written with a dollar sign and a decimal point. \$1.75 + 8c = \$1.75 + \$.08 or \$1.83. To add yards to feet, the yards are changed to feet or the feet to yards. The sum of 6 yards and 4 feet equals 18 feet + 4 feet, or 22 feet.

ADEN (ä'dën). The "Gibraltar of the East," as Aden is frequently called, is a British colony on the southwestern coast of Arabia, at the southern entrance to the Red Sea. The town, which is on a rocky promontory and is strongly fortified, was acquired by the British from the Turks in 1839. It is valued chiefly because its possession, together with the ownership of the Suez Canal, gives Great Britain control of the shortest sea-route to India.

Aden and a small strip of adjoining territory are administered as a British protectorate under the government of Bombay, India. The harbor is good and Aden is one of the chief coaling stations on the

Suez Canal route. There is considerable trade in coffee, gums, and hides. Population, about 50,000.

ADIRONDACK (ăd-î-rŏn'dăk) **MOUNTAINS.** In north-eastern New York lies a public playground, the great Adirondack forest reserve, more than half as large as the State of Connecticut. The rugged beauty of its wooded mountains, its silvery streams and lakes, the abundant fish and game, and its comparative accessibility, make of it a favorite summer resort for all eastern America.

From the romantic waters of Lake George and Lake Champlain the mountains are seen as a succession of bold rocky headlands with wide receding valleys between. Most of the tops are rounded and dome-like, but here and there sharp peaks jut upward from the surrounding sea of verdure. Picturesque passes also occur at frequent intervals to delight the traveler who journeys by stage or automobile from one lovely valley to another.

The Adirondacks lie between Lake Champlain on the east and the St. Lawrence River on the west. Mt. Marcy, the highest summit, is 5,344 feet above sea level. The forests, especially the white pine, are very valuable. Some geographers class the Adirondacks as a part of the Appalachian mountain system, but physically and geologically the two are distinct.

The forest reserve established by the State of New York not only preserves the natural beauty of the region and provides a great recreation ground; it also tends to prevent the destructive alternation of floods and droughts which follow when extensive mountain tracts are deprived of their forests. A sanitarium, open throughout the year, for the treatment of consumptive patients, is located at Saranac Lake, one of the most picturesque of the many bodies of water scattered throughout the region.

ADJECTIVE. Suppose your little brother is lost and you are trying to tell the police what he looks like. You say something like this:

"Johnny is a short, light-haired, blue-eyed, little boy."

Now the words you have used to describe him—*short, light-haired, blue-eyed, little*—are words that you have added to the noun *boy* to make its meaning clearer and more definite. Such words we call adjectives, from the Latin word meaning "added to." They are always "added to" nouns or pronouns and, as we say, modify them.

Adjectives are "compared" to show degree—as *deep, deeper, deepest*. The first of these forms is the positive degree, the second is the comparative, and the last is the superlative. Sometimes *more* and *most* are used, especially when the addition of the syllables *er* and *est* would make the word difficult to pronounce; as, *beautiful, more beautiful, most beautiful*. A few adjectives have irregular comparison—as, *good, better, best; bad, worse, worst; little, less, least; many or much, more, most*.

Adjectives which merely describe are called *descriptive* or *qualifying* adjectives. Adjectives which point out or locate (*this, that, yonder, etc.*) are called *demonstrative* adjectives, from the Latin verb meaning "to point out." There are several kinds of demonstrative adjectives: *numeral* adjectives (*two, three, etc.*); *ordinal* adjectives (*first, second, etc.*); *articles* (*a, an, the*). *Interrogative* adjectives ask a

question (*Which book? What man?*). *Possessive* adjectives denote possession (*my book, his pencil*).

One of the commonest mistakes in the use of adjectives is to use the superlative degree instead of the comparative when only two objects are compared—as, "John is the *tallest* of the two boys," for "John is the *taller* of the two boys." There is also much perplexity as to whether an adjective or an adverb should be used after certain verbs. As a general rule, the adverb should be used if it could be replaced by a phrase denoting manner; the adjective should be used if some part of the verb "to be" could be substituted for the verb. Thus: "He felt *cold*" (that is, he *was* cold); but, "He felt *rapidly* around for the matches" (expressing manner). "She looked *shy*"; but, "She looked *shyly* up." "The man appeared *kind*"; but, "The man appeared *suddenly*." Sometimes either adjective or adverb may be used with little difference of meaning; as, "They arrived *safe* (or *safely*)."

ADOLESCENCE. The word adolescence is used to designate the period of transition from childhood to adult life. It comes from a Latin term which means *to grow up*. It may be conveniently divided into two stages: (1) that of *early adolescence*, beginning at the age of 11 or 12 in girls and 13 or 14 in boys, and lasting till about the age of 16 or 18; (2) that of *late adolescence*, from 16 to 21 in girls and 18 to 25 in boys. Of course lines of demarcation cannot be too rigidly drawn, or characteristics of special periods too strongly emphasized, particularly as the nature of development varies considerably with different persons.

The Dawn of Manhood and Womanhood

After the somewhat slow growth of later childhood there is at the beginning of adolescence a sudden shooting up in height, closely followed by a rapid increase in weight. In both boys and girls the body now begins to assume the adult form, and pronounced differences appear. In boys the beard begins to grow and the voice changes and deepens, the rapid growth of the larynx making accurate control of the vocal organs for a time impossible. Boys often exhibit, and are sensitive to, awkwardness in the management of their overgrown bodies. Latent capacities and interests develop, the features change to show new characters, and hereditary influences become more pronounced.

The essential characteristic of early adolescence is the unfoldment of the functions pertaining to sex. The youth suddenly finds himself susceptible to the influence of the opposite sex. A new interest in dress and personal appearance usually develops, and often a tendency to show off on account of the newly awakened regard for the good opinion of persons of the opposite sex. These sex instincts, like all other instincts, should be properly directed, strengthened, or restrained, in view of their future function on the one hand and the danger of perversion on the other.

The distinctive mental and emotional traits of this period are perhaps more variable than the physical ones, but scarcely less pronounced. In thought and feeling, as well as in appearance, the boy becomes specifically masculine and the girl feminine. It is a time of great increase in mental and emotional vigor, of tremendous enlargement of the sphere of interests and broadening of the mental horizon.



The beauties of nature, of poetry, and of art begin to appeal, and the soul can be profoundly stirred by religious and ideal sentiments. The youth comes to look upon himself in the light of his larger relations to the race and to society, and to attempt a personal readjustment to the larger view of life thus opened up. Intellectually he becomes capable of comprehending broader generalizations and larger thoughts. Periods of enthusiastic energy and noble attempt at high achievement often alternate with periods of languor, depression, and doubt.

Sympathetic Treatment Needed

The stage here gradually shades off into that of late adolescence, which is essentially a time of fixing the framework of the personal habits, ideals, and relationships of life. It is normally a time of choosing a life profession and of taking the initial steps toward entering upon it. It marks the transition from a state of dependence upon others in matters material and intellectual to one of independence, showing itself in the development of a characteristic personality capable of thinking and acting as such. Outbreaks against restraint and authority often seem to occur almost instinctively at this period, and should be dealt with sympathetically by parents and teachers. Much needless and harmful friction and misunderstanding are caused by the failure of adults to comprehend the real nature and cause of these outbreaks.

Professor James's words of encouragement in this connection have been so helpful to many adolescents that they are here quoted at length: "Let no youth have any anxiety about the upshot of his education, whatever the line of it may be. If he keeps faithfully busy each hour of the working day he may safely leave the final result to itself. He can, with perfect certainty, count on waking up some fine morning to find himself one of the competent ones of his generation, in whatever pursuit he has singled out. Young people should know this truth in advance. The ignorance of it has engendered more faint-heartedness in youths embarking upon arduous careers than all other causes put together."

ADONIS (*ă-dō'nīs*). Of all the youths beloved by the goddess Aphrodite (Venus), Adonis was the most fair, and for him the glorious goddess forsook the heights of Mount Olympus to wander through earthly woods and fields. But Adonis was a bold young hunter, and his rash pursuit of dangerous game caused Aphrodite many anxious moments. In vain she besought him to forego the hunt and remain with her. Adonis laughingly escaped and continued to join the other hunters in his favorite sport.

Then one day he came upon a wild boar especially large and fierce. When he wounded it with his spear, it turned and charged him, burying its tusks in his sides and rending and trampling the poor youth to death.

The grief of Aphrodite at this mishap was pitiful. Rushing to Adonis' side, she knelt over him and burst into a passion of tears. As they dropped upon the

ground these were changed into anemones, while the red drops from Adonis' side were transformed into red roses. A Greek poet, in describing the lament of Aphrodite, says:

As many drops as from Adonis bled,
So many tears the sorrowing Aphrodite shed:
For every drop on earth a flower there grows:
Anemones for tears; for blood the rose.

Time did not soften Aphrodite's grief, and going to Olympus she implored Zeus to restore her lover to earth. And so it was arranged that Adonis should spend one half of every year in the upper world. In the early spring he left the Elysian Fields to join his beloved, and on his path the flowers bloomed and birds sang to show their joy at his coming. But when winter came he returned to the land of the dead, and all nature drooped in mourning at his departure.

ADRIANOPE (*ăd-rĭ-a-nō'pl*). Named in honor of the emperor Hadrian (117-138 A.D.), this city, the scene of many important events in the troubled history of the Balkan lands, lies 130 miles northwest of Constantinople. Near it the Visigoths in 378 A.D. won the memorable victory over the emperor Valens, which began the downfall of the Roman Empire. The Turks captured Adrianople in 1360, and made it their capital until they won Constantinople nearly a hundred years later.

In 1913 Adrianople was taken from the Turks by the Balkan allies, but was restored in the peace which followed. Its transfer to Greece, following the close of the World War (1920), was one of the causes of the Turkish nationalist rising against the Paris peace decisions. Population, about 80,000.

ADRIATIC (*ă-dri-ăt'ic*) **SEA**. This great arm of the Mediterranean separates Italy from Trieste, Croatia, Dalmatia, and Albania, and is sometimes regarded as peculiarly an Italian sea. Its greatest length is 450 miles and its mean breadth 90 miles. The Po is the most important river flowing into the Adriatic Sea, and the chief cities bordering it are Venice, Trieste, Fiume, Ancona, and Brindisi.

From the 12th to the 18th centuries the rulers of Venice each year went through the form of throwing a ring into the Adriatic (called "wedding the Adriatic"), in token of their claim to dominion over that sea. The name comes from the little town of Adria, just north of the mouth of the Po, which though once a flourishing seaport is now 15 miles inland.

ADVERB. When your father asks you how you got along in your studies yesterday, you answer:

"I did well," or "I did poorly."

You have answered his question by adding the word *well* or *poorly* to the verb *did*. Words that are thus added to verbs to modify their meaning are called adverbs, getting their name from the Latin words *ad* meaning "to," and *verbum*, "verb." Adverbs may also modify adjectives, other adverbs, or prepositions—as, *very* tall (modifying an adjective); *too* slowly (modifying another adverb); *just* above the house (modifying a preposition).

The most interesting characteristic of adverbs is their great variety of meanings. They may express time (*today*), place (*here*), manner (*quickly*), degree (*very*), number (*once, twice*), exclusion (*but, once, only*), etc. Some adverbs, called *conjunctive* adverbs, also connect adverbial clauses with other parts of a sentence—as, “He left *before* I arrived.” Others, called *interrogative* adverbs, introduce questions—as, “*When* did you come?”

Most adverbs are formed from adjectives by adding the suffix *ly*—as, great (adj.), greatly (adv.); real, really; splendid, splendidly. But some adverbs have the same form as the adjectives; for example, “a *fast* train” (adj.), and “run *fast*” (adv.).

Adverbs are generally compared (see Adjective) by the use of *more* and *most*; an example is, freely, *more* freely, *most* freely. Some, however, are compared like adjectives by adding *er* and *est*. Thus we say, “John runs *fast*, but Henry runs *faster*.” “You and John climbed *high*, but I climbed *highest*.” The adverbs *well, badly, much, little*, have the same irregular comparison as the corresponding adjectives, *good, etc.*

The chief difficulty in the use of adverbs comes from confusion with adjectives. *Real* kind, doing *fine*, write *good*, etc. are common mistakes for *really* or *very* kind, doing *well*, write *well* or *neatly* or *legibly*, etc.

AEGEAN (ē-gē'an) CIVILIZATION. In the island-strewn Aegean Sea, European civilization had its birth; and across its waters, for 5,000 years, have interlaced the threads of European, Asiatic, and African commerce and history. Here Europe thrusts southward its easternmost peninsula toward the boldly jutting mass of Asia Minor. Across the narrow basin between, East and West have faced and fought each other since the dawn of history.

What a panorama unfolds before the imagination when one thinks of the nations whose vessels have plowed the Aegean—ancient Egyptians, Cretans,

and Phoenicians; Persians, Athenians, and Spartans; Romans, Goths, Venetians, and Arabs; modern Turks, Greeks, and Italians—these are some of the many peoples who have made history in this sea, down to the World War of 1914-18, when its islands were seized as coigns of vantage against Turkey and her allies.

WHERE EUROPEAN CIVILIZATION WAS BORN



In Europe, civilization dawned in the three cities of Mycenae, Argos, and Tiryns, on the mainland of Greece. But this civilization began in the island of Crete, which in turn owed the beginning of its development in the arts and industries to Egypt and Asia. From Crete the light spread not only to Greece, but was carried by the Cretan sea kings, in connection with their commerce, to Sicily and Italy on the west, and to Troy on the north. We are apt to think of Troy as only an imaginary place, the creation of a great poet's brain, but how substantial it seems when we know that it really existed some three thousand years ago, and that it had paved streets, formidable stone walls, and elaborate buildings. The great palace in Cnossus (Crete) had running water, bathrooms, and other “modern” conveniences.

This historic sea is the northeastern arm of the Mediterranean, and forms a body of water about twice as large as Lake Michigan. It is partly shut off to the south by the long narrow island of Crete, which lies squarely in the middle. Look at the map and see how thickly it is dotted with islands, which form a natural bridge between Europe and the East.

Civilization Comes from Egypt

More than 5,000 years ago, at a time when the ancestors of the modern European peoples were still barbarians,—without metals, without money, without writing, without sailing ships, and without comfortable houses—the people who lived in this Aegean

basin had taken the first steps upward from barbarism. Under the influence of their highly civilized neighbors of the valleys of the Nile and of the Tigris and Euphrates, they too developed a civilization worthy to be compared with any that had before existed. In Crete and at Troy and elsewhere on the mainland, they built paved cities with massive fortifications.

This contact first took place between Crete, the southernmost of the Aegean islands, and the Egyptians, who were only a three days' sail to the south. By 2000 B.C. the Cretans had become a highly civilized people. Their war and trading galleys made the Aegean and other parts of the Mediterranean a Cretan lake, and the kings of Crete received tribute

AEGEAN ART 1,000 YEARS BEFORE CHRIST



While the Greeks were still unlettered barbarians, the skilled artists of the Aegean were turning out such wares as those shown above. The great ornamented oil-jar—large enough to hold one of the Forty Thieves of Ali Baba in the 'Arabian Nights'—was found in the great palace at Cnossus (Crete). The marble throne is from the throne room of the same palace. Above is a famous gold cup found at Vaphio (near Sparta), with marvelous representations of the netting of wild bulls. The wine-jar (*amphora*) shows typical Cretan use of sea figures in decoration. Most wonderful of all is the tiny ivory statue of the Cretan snake goddess, remarkable alike for the grace and charm of the figure and its extremely modern flounced costume. It comes to us like a breath of today across the 3,000 years which separate us from those recently discovered times.

They raised great stone palaces, richly decorated with paintings and sculptural ornaments, and equipped with running water, bathrooms, drainage, and other conveniences which we regard as typically modern. They developed an art of extraordinary interest, producing work in pottery, metals, and carved gems that has rarely been surpassed.

Crete the Center of Mycenaean Civilization

We call this civilization the *Aegean civilization*, and the people who developed it we call the *Mediterranean race* (see Races of Mankind). We know that this people had lived in the Aegean basin from far back in the Stone Age. But they did not begin to progress from barbarism to civilization until about 3000 B.C., when they first came into frequent contact with the flourishing and progressive Oriental peoples, especially the Egyptians.

from many dependencies. The great legendary sea-king of Crete was Minos, and from his name the term "Minoan" Age has been applied to the whole period of nearly 2,000 years, when Cretan influence was dominant in the Aegean.

The first dwellers on the Grecian mainland to feel this influence were the people of the gulf of Argos, which looks south directly towards Crete, and was only a two days' sail for the adventurous Cretan traders. The rude inhabitants of Mycenae and Tiryns, the two chief settlements on the Argive plain, bought the beautiful wares of the Cretan traders, and in course of time developed a high civilization of their own. At one time, before Crete was known to be the center of this civilization, the name "Mycenaean Age" was given to the period when Mycenae and Tiryns flourished (1500-1200 B.C.), because of the

wonderful gold cups, sculptures, and other articles discovered there. Other cities on the Greek peninsula and on the Aegean islands shared in this culture, which was spread as far as Sicily, Italy, and Spain by the roving Cretan traders.

Troy One of Its Outposts

On the mainland of Asia Minor, too, the same general type of civilization sprang up, beginning there 1,500 years before the great palaces of Mycenae and Tiryns were built. The famous city of Troy, in the northwestern corner of Asia Minor, near the shores of the Hellespont, was the Asian center of this Aegean civilization. At first a mere trading village, by 2500 B.C. Troy had become a rich and sumptuous capital, scarcely inferior to its great rival Cnossus, the capital of Crete. In another thousand years Troy had spread its power over its neighbors and had become the mistress of a considerable kingdom (*see* Troy).

But by the time the use of iron had become common in the Aegean (about 1000 B.C.), the widespread Aegean civilization had received its death blow at the hands of Indo-European invaders from the north. These peoples we know as the Greeks. At that time they were still rude barbarians. In wave after wave they swept down into the peninsula of Greece and across the Aegean. The proud kingdoms of Mycenae and Troy and Cnossus fell before their resistless advance, and were so completely overwhelmed that their memory survived only in confused traditions whose meaning we are only now beginning to unravel.

A New World Revealed by Excavations

Two generations ago men knew nothing of this first great chapter in European history. The palaces and vases and weapons and paintings of this pre-Greek epoch lay silted over beneath the sands of the ages. It was not until Heinrich Schliemann in 1870 began to dig down through the deposits that hid the buried city of Troy, that the story of Aegean civilization began dimly to be suspected (*see* Schliemann, Heinrich). Then followed excavations at Mycenae and Tiryns and other places, until today we have a great number of remains of this forgotten civilization, which tell its story as eloquently as words.

Nowhere else have such impressive survivals of the earliest Aegean culture been found as in the island of Crete. At Cnossus and Phaestus and other cities of Crete, excavators have uncovered great palaces, with a wealth of weapons, tools, pottery, statuettes, and other objects. Here too they have found thousands of clay tablets covered with writing, which we are still unable to read. Pictures of bull-fights, festal processions, crowds, and acrobats show us what a highly developed civilization they enjoyed, curiously like our own in some respects. The tiny statuettes show us ladies' costumes with tight bodices, flounced skirts, and elaborate coiffures like those which recur from time to time in modern fashions.

A half-century of patient labor with pick and shovel has thus revealed to us one of the most fascinating

periods of history. Now that Turkish power in the Aegean has at last been overthrown, the work of excavation can be pushed with renewed energy, and new discoveries will doubtless enable us to increase our knowledge of the men who first brought the light of civilization to Europe.

From the dawn of history to the present, most of the people inhabiting the Aegean islands have been of this ancient Mediterranean race. Intermixtures, however, have occurred with Greeks and later conquerors. From the Roman conquest of the Mediterranean almost down to our own times, the islands have worn the yoke of foreign domination. When Greece at last shook off Turkish domination (1821-1830), many of the islands were joined to the new Hellenic kingdom. Nearly a century later the Balkan wars and the World War of 1914-18 restored most of the remainder to Greek rule.

AENEAS (*ē-nē'ās*). According to the stories which the old Romans loved to tell, their imperial City of the Seven Hills was settled by men descended from the heroes of lofty-towered Troy. Aeneas, son of Anchises and the goddess Aphrodite (Venus), was the leader under whom this little band of Trojans reached Italy and settled on the plain of Latium.

Aeneas, according to the story, was the bravest of all the Trojans after Hector. When Troy was conquered and burned, he escaped from the city with old Anchises on his shoulders and leading his young son by the hand. For seven years he and his companions wandered over the Mediterranean in their swift-oared ships.

Near Carthage on the African coast Aeneas was wrecked, and the Carthaginian queen Dido loved him and begged him to stay. But the gods sent him wandering again, and Dido killed herself for grief.

After further wanderings Aeneas came at last to Latium, a land in central Italy, whose king welcomed him and gave him his daughter in marriage. For years, so the story goes, Aeneas reigned happily over the united Trojans and Latins. Then in battle with the Etruscans he vanished; and his subjects, failing to find his body, believed that he had been carried to heaven, and worshiped him as a god.

Aeneas is the hero of the most famous epic in Latin, the 'Aeneid' of Vergil. There he is frequently called "the pious Aeneas" because of his loyalty and devotion to his father Anchises.

AEOLUS (*ē'ō-lūs*). In a wonderful island in the western Mediterranean Sea dwelt the ruler of the winds, the god Aeolus, son of Poseidon (Neptune). With him lived Boreas, the god of the fierce north wind; Notus, the south wind that brought fogs and rain; Eurus, the bleak east wind; and Zephyrus, the gentle wind from the west.

Once Odysseus (Ulysses) touched at the island in the course of his wandering return from Troy; and Aeolus, wishing to hasten Odysseus' return home, gave him all the unfavorable winds—the north, south, and east—safely confined in an ox-hide bag.

With the west wind blowing steadily, and the other winds safely imprisoned, Odysseus' ship flew swiftly homeward. But on the tenth day the sailors, believ-

THE GREAT STORY-TELLER WHO MADE THE ANIMALS TALK



This is the famous old story-teller Aesop entertaining a group of eager listeners on a hillside on some afternoon in the golden days of Greece, the Greece of long ago. How the Greek boys must have learned to love the sight of that homely face and called out to each other as they saw him coming: "Oh, here's that wonderful man that makes the animals talk!" And the grownups liked his stories just as well, for in them Aesop tucked away a lot of sound advice and shrewd criticism of human weaknesses that apply just as much today as in the far-away days when first he told them. Perhaps that is why they have lived so long.

ing a treasure was in the bag, opened it while Odysseus slept. The released winds then blew the ship back to the island. There Aeolus, angry at the abuse of his kindness, refused the ship further aid.

From Aeolus is named the Aeolian harp, a musical instrument made by stretching catgut strings or wires over a thin sounding box, the strings being tuned as in a violin. When placed in a partially closed window, where there is a draught of air, the passing of the wind over its strings produces strange and melancholy musical sounds, varying with the rise and fall of the breezes.

AESOP (ē'sŏp). The frogs, according to the fable, were grieved because they had no king and sent ambassadors to Zeus, chief of the gods, to ask him for a ruler. Realizing that the frogs were very stupid, Zeus cast down a log into the pond. The frogs were terrified at the splash it made as it hit the water, and sought shelter at the bottom. When they noticed that the log did not move they grew to despise this lifeless ruler and climbed over the log and squatted upon it.

After some time they again sent messengers who requested the god to appoint another sovereign.

This time Zeus sent an eel to the pond. He was an easy-going, good-natured fellow, and the frogs thought that he too made a very poor king.

So they sent a third time to the god to ask for a different ruler. Zeus was now out of patience and sent them a stork, who each day ate up a frog or two until soon there were none left to croak and complain.

This story, which is said to refer to the seizure of power over Athens by the tyrant Pisistratus, is a very good example of Aesop's fables. Tradition says that Aesop, who lived from about 620 to 560 B.C., was originally a Greek slave, ugly and deformed in person but of brilliant mind. In his fables animals are made to act and talk as human beings, and moral lessons and bits of wisdom are conveyed in such a forceful and delightful way that they have been popular with young and old for many centuries.

Aesop was freed by his master after a time, and gained such a reputation that he was invited to live at the court of Croesus, King of Lydia. His end

came, it is said, when he was sent by Croesus to the temple of Apollo, at Delphi, where he so aroused the anger of the Delphians that he was thrown from a precipice.

Aesop did not write out his fables, but recited them and they were handed down from memory. Over two centuries later an Athenian wrote down the fables as they were then told, and still later a Greek named Babrius made another collection of them. For a thousand years they were lost to memory, until a copy of the collection made by Babrius was found in the monastery of Mt. Athos in 1844. It is from this collection that later translations have been made.

AFGHANISTAN (*ăf-găn-i-stăn'*). On Tuesday and Friday mornings long lines of shaggy one-humped camels and stout heavy-shouldered *yabus* (horses) enter each end of the most important gateway into Afghanistan—Khyber Pass. Only twice a week does the Amir, the absolute monarch of the Afghans, undertake to police the pass so that travelers will not be set upon and robbed by the marauding Afridi tribes, who lie in wait for unwary comers.

The incoming and outgoing caravans meet about noon at a half-way station. It is the hour of prayer. The rocky flat of the dry river-bed at the side of the dusty road is then dotted with rectangular bits of color—wonderful prayer-rugs on which kneel the turbanned figures of the Mohammedan camel-drivers and traders bobbing up and down, their long arms extended in front of them, as they worship Allah their god and Mohammed his prophet.

The incoming caravans start from Peshawar, the nearest railway terminus of British India. Occasionally a Hindu, perhaps a shopkeeper returning to Kabul, the capital of the Amir, is a traveler in this motley crowd; and sometimes a white-faced European—but rarely. For a European must have a special permit, viséd by both British and Afghan authorities, before he is allowed to enter this forbidden country.

Into India these shuffling beasts of burden carry gorgeous embroideries and carpets from Bokhara and Persia; wool, silk, dried fruits, madder, and asafetida, much liked by the Hindu as a food seasoning; horses

for the Indian army; hides and tobacco. Back into their mountain fastnesses they take cotton goods, tea, and sugar.

The Afghan is primarily a soldier and farmer, and looks with scorn upon all forms of handicraft and shopkeeping. The word "Afghan" means "noisy and turbulent," and this warlike and treacherous people seem to merit the name. They claim descent

from the lost tribes of Israel and have decidedly Jewish features. Every educated Afghan can read and speak Persian, which is the language of the court and of literature.

The importance of Afghanistan, the area of which (about 245,000 square miles) is a little less than that of Texas, lies in its situation as a "buffer state" between British India and Russia. Two costly wars (1838-42 and 1878-80), plus a constant subsidy from the Anglo-Indian government, have enabled the British to control the foreign policy of Afghanistan, although it is independent in local matters. In the second Afghan war the famous

English general Lord Roberts made a sensational march from Kabul to relieve a British force besieged at Kandahar. This feat impressed the Afghans with the power of the British, which had been shaken by earlier disasters. During the World War of 1914-18, German-Turkish intrigue resulted in the murder of the reigning Amir, and an unsuccessful attack by the Afghans on British outposts.

Geographically Afghanistan is a lofty plateau on which very high mountain ranges extend in a general southwesterly direction from the Hindu Kush to the Persian boundary, sloping off into desert country in the south. A branch of the Russian Transcaspian railway terminates about 150 miles north of Herat, at the boundary and a British-Indian railway carries passengers as far as Peshawar, a few miles southeast of the entrance to Khyber Pass. No railway actually enters Afghanistan. This is the result of a deliberate policy of exclusion on the part of the Afghans, and of international jealousies. Trade routes with fairly good roads lead into Turkestan and India, and connect the principal cities of Afghanistan—Kabul, Ghazni, Kandahar, and Herat. The mineral resources of Afghanistan are gold and silver (in small quantities), coal, iron, antimony, lead, sulphur, gypsum, and niter. Population, about 6,400,000.

AFGHANISTAN AND ITS MOUNTAIN WALLS



The very land looks as restless as the sea, so we are not surprised to learn that "Afghan" means "noisy and turbulent," for mountaineers the world over are warlike. Few Europeans or Americans visit this "forbidden land," and none is allowed to enter without a *firman* or permit signed by the Amir. The map shows plainly the importance of Afghanistan as a "buffer state," lying between Great Britain's Indian possessions on the south and portions of the former Russian Empire on the north.

The BLACK MAN'S Vast and Mysterious CONTINENT

AFRICA. Six thousand years ago Africa was the home of the most civilized nation of the world, yet today we may say that the civilization of Africa has just begun. The work of the ancient Egyptians, great as it appears, was a mere scratch on the surface of the vast African continent. Farther west Phoenician traders settled and laid the foundation of Carthage, which for a time challenged the supremacy of Rome. But only a few ruins of the Carthaginians also are left to mark the scene of their flourishing culture.

One after another Greeks, Romans, Vandals, and Arabs occupied the Mediterranean fringe of the "Dark Continent." Great cities were built, prosperous states grew up, arts and letters flourished, Christianity was established and then succeeded by

Extent.—From Cape Blanc (37° 21' N.) to Cape Agulhas (34° 51' S.); and from Cape Verde (17° 33' W.) to Cape Guardafui (51° 21' E.). Length, 5,000 miles; breadth, 4,600 miles; area, 11,262,000 square miles.

Population.—150,000,000 blacks, 20,000,000 light races.

Sahara Desert.—Area, 3,500,000 square miles, the largest desert in the world.

Chief Rivers.—Nile (4,000 miles); Congo (about 2,800 miles—greatest volume of water of any river in the world except the Amazon); Niger (3,500 miles); Zambezi (1,800 miles).

Highest Mountain.—Kilimanjaro (19,720 feet above the sea).

Largest Lake.—Victoria Nyanza (230 miles long), next to Lake Superior the largest in the world.

Greatest Cataract.—Victoria Falls on Zambezi River, 400 feet high and one mile wide.

caravans. A few adventurers landed on the west coast seeking ivory and slaves, and others traded for gold on the eastern shores. Bold navigators touched now and then at southern points on the way to India. But of the vast interior nothing was

surely known. America was discovered, colonized, conquered, and civilized, while Africa remained a mysterious land. Australia opened its doors to the white man, while the Congo forests still barred his way. Explorers came ever nearer to the North and the South Poles, before they had succeeded in tracing the full course of the Equator across the tangled forest interior of Africa.

The story of how the dark veil which had hung almost undisturbed for ages was suddenly torn aside

LIVING CAIRO IN A CEMETERY OF DEAD CITIES



The Cairo we know today was founded away back in 968, more than 500 years before Columbus discovered America. But that was a comparatively recent event in the history of Egypt, for in a space of some 18 miles around the site of the Cairo of today, many cities had previously risen and crumbled back to ruin. Among these cities were Memphis and Heliopolis and a town named "Babylon." This Babylon was founded by immigrants from Mesopotamia who named it after the big Babylon, just as we have small cities scattered over the United States named after the big cities; 5 Philadelphias, for example, 8 Edinburghs, 9 Londons, and 18 Parises.

Mohammedanism. But none of these peoples ever measured its strength against the mysterious forces of the interior, or reached beyond a narrow strip along the northern sea. The roots of civilization remained planted in Europe and Asia. The faces of the settlers were always turned northward, while a hundred miles to the south the silent wilderness of desert or jungle watched night and day, ready to swallow up their work the instant their vigilance was relaxed.

Africa Long a Land of Mystery

Picture this immense territory lying at Europe's door for thousands of years, but always keeping its secret, hiding its treasures and its millions of inhabitants. Reports of giant apes and dwarf peoples came out of the interior by means of rare Arab

in a brief 25 years is one of the most romantic pages in the history of civilization. But before we consider that adventurous period, we must see why it was that Africa remained so long impenetrable.

Why Africa Remained Dark So Long

Turn to the map of Africa as we know it today. From the tip of Cape Blanc in the Mediterranean to Cape Agulhas at the extreme south, the continent measures 5,000 miles. From Cape Verde in the west to Cape Guardafui in the east, the width is 4,600 miles. Between these four points lies a territory of 11,262,000 square miles, nearly one and one-half times the size of North America, three times as large as Europe, and more than one-fifth of all the land area in the world.

But consider how compact this mass of land appears. Cut off by water from the rest of the world, except for the 80-mile strip of the Suez isthmus in the northeast, Africa presents an almost unbroken coast on all sides. Compare this with the twisting outlines of Europe, with its maze of gulfs and bays, promontories, peninsulas and islands, and you will see the first answer to the African puzzle. Africa's armor is tightly welded; there is little or nothing to "take hold of." If you should set out from the north end of the famous Suez Canal and walk around Africa without leaving the coast line, you would travel only 16,100 miles. If you do the same for Europe, which is less than one-third as large, you will walk three times as far. The saw-tooth shores of tiny Norway alone wriggle on for nearly 12,000 miles.

Few Harbors to Welcome Ships

Naturally, therefore, Africa offered few sheltering harbors, and early seafarers did not come often or linger long on such inhospitable coasts.

Consider next the structure of the land itself. In contrast with other continents, Africa has an exceedingly small area of low ground. Almost everywhere the walls of the great tablelands rise abruptly a short distance from the sea. The coastal strip between is usually barren and filled with brackish mangrove swamps. Early explorers found that the few great streams which succeed in breaking through these coast walls are almost invariably closed by sandbars at their mouths, while their courses higher up are interrupted by rapids and cataracts, which made travel even in small boats next to impossible.

But these obstacles, forbidding as they appear, are only the defenses of the outer gates. Turn your back to the Atlas Mountains in the northwest and to the site of ancient Carthage on the bay southeast of Cape Blanc, or leave the ruins of the old Greek settlement of Cyrene on the promontory east of the Gulf of Sidra, and travel southward. Before many miles, the rocky hills smooth out into rolling sand dunes stretching endlessly toward the horizon. Trees and vegetation disappear. The heat grows intense, pouring down from above, then rising again in shimmering waves from the burning ground. This is the beginning of the Great Sahara, which for ages turned back the tide of civilization approaching from the north.

This ocean of sand, spread out across the continent for 3,500,000 square miles, greater in size than the whole United States, is without a single river, from the Nile on the east to the Atlantic Ocean on the west. Here and there those who know the way can find an oasis, a rare spot where a bit of water has forced its

way to the surface, giving life to date palms, acacia bushes, and a patch of green herbage. Straggling from one distant oasis to another are ancient caravan routes, along which are scattered the whitened bones of men and beasts, bleached by the sun and the dry sirocco or simoom winds, or buried in the ever-shifting sand.

The only living things to be seen, aside from a few prowling jackals, are occasional hooded figures mounted on camels, the "ships of the desert"—for the camel is the only pack animal that can stand the fearful test of the Sahara. The wayfarers may be wild Tuareg tribesmen, the pirates of the sand, cruising swiftly in search of a caravan to plunder; or they may be the swifter *meharistes*, the French desert police, recruited 1,200 strong in the far north and sent to keep order in this tremendous wilderness.

But if we don't lose our way and the water holds out, we shall pass through the desert and the

steppes into a greener land beyond, where the real Africa of the Africans begins—that central plateau and forest region which stood out to the last against the explorer, the scientist, the missionary, and the soldier. Here is the home of the hundreds of negro tribes, which shade off in the north into Arab and Egyptian, and in the south into Hottentot and Bushman.

The Western Gates to the Continent

It would perhaps be better to enter this region from the west, in the footsteps of the first explorers, for the sinister desert route is not the best way into the heart of Africa. Let us land, then, on the Guinea Coast, the Ivory Coast, the Gold Coast, or the Congo coast—those western shores whose romantic names conceal a history of cruelty, suffering, sacrifice, disease, and death, unparalleled perhaps in the world. It was here that the ranks of American slaves were recruited, and here also that the early missionaries tried to win back the confidence of the savages, so sadly abused by their unscrupulous white "brothers." Here for nearly 100 years the fierce negro warriors of the Ashanti kingdom successfully resisted the British.

BIG CHIEFS—THREE OF THEM!



Among their own people these three are very distinguished men. They are three chiefs of tribes in British East Africa. As there are several million of these natives it would make us feel a little easier, if we were actually face to face with them, to see that one of these chiefs has a tuft of wool on the end of his spear; for that means that all three of them are at peace, and so, of course, are their people.

And it was in this region that the dread African fever carried off such an enormous number of victims that the west coast became known throughout the world as the "white man's grave."

Two great rivers water this region, the Niger and the giant Congo. The latter is the largest river in Africa, and next to the Amazon the largest in the world if we count the volume of water that it pours into the ocean.

The country drained by these rivers is not unlike the tropical forest region of South America, except that it is somewhat higher and far more densely inhabited. Crossed by the Equator, it is marked by fierce heat and tremendous rains, which together produce for hundreds of miles a tangle of trees and vegetation so thick that it can be crossed only over the narrow foot-paths, beaten by the naked feet of savages for hundreds of years.

The elephant and the hippopotamus are able to force their way through this jungle, but few other large animals venture here. However, the giant trees, interlaced with huge creepers and vines, form the natural home of the chimpanzee and the great gorilla, who build their nests in the thick foliage. Countless other varieties of monkeys chatter in the tree tops, dining on wild fruit and nuts, rarely descending to the ground except for water. Innumerable parrots and other birds of bright plumage dwell here, while insects find it a paradise. Africa, having comparatively few poisonous snakes, is said to have more varieties of scorpions, centipedes, spiders, ants, and other such creatures which bite and sting, than any other part of the globe. Worst of all is the *tsetse* fly, whose bite is fatal to cattle, horses, and dogs, and which spreads the fatal "sleeping sickness" that kills thousands of natives and scores of white men every year.

This vast region of woods is inhabited by numberless fragments of tribes, usually at war with each other, who live apart from 10 to 50 miles in clearings. There they grow the plantains, bananas, beans, tobacco, gourds, melons, etc., on which they live.

The Eastern Coast

Turning to the east coast we find different conditions. Although fever infests the shore line here also, the land rises to greater heights, usually affording quicker relief from the tropical heat. In fact it is on the east side of Africa that the chief mountains of the continent are massed, running parallel to the shore line from the Red Sea in the north to the southern

capes. About 200 miles from the coast and 200 miles south of the Equator, the peak of Kilimanjaro soars 19,720 feet, the highest mountain in Africa, on whose broad sides dwell more than 200 independent tribes.

Mountains in equatorial Africa have the peculiar habit of rising suddenly out of the ground without the assistance of many foot-hills. They do not run

in great ranges, but seem to have been thrown up separately, while between them are wide stretches of high prairie or plateau land, called in central Africa "savannas" and in the south the "veldt." These prairies are usually rocky, dotted with woods, and covered with brush and tall grasses, and are the favorite home of African big game.

The Sudan and Lake Chad

Look again at the map. The African savanna region stretches from the Senegal River on the extreme west coast directly eastward to the headwaters of the Nile, including the Sudan and forming the northern boundary of the great forests and the southern boundary of the Sahara. It then turns southward, takes in the territory of the great lakes, then back to the west coast again, encircling the forests, while a broad spur stretches toward the southeast shores. This is the land of the lion, the leopard, the hyena and its relative the aard-wolf or earth wolf, the rhinoceros, the buffalo, the zebra, the wild boar, the giraffe and his strange cousin the okapi, the ostrich, the hartbeest, and scores of other antelopes and gazelles. Here also grows the gigantic baobab or monkey-bread tree, and the tall elephant grass.

The tribes which inhabit this region, usually grouping themselves about the more thickly wooded mountain slopes or highlands, have generally reached a higher degree of civilization than their forest neighbors. They are organized into larger and more powerful tribes, and it is their warlike character, rather than the nature of the country itself, which has proved an obstacle to the white man in this portion of Africa.

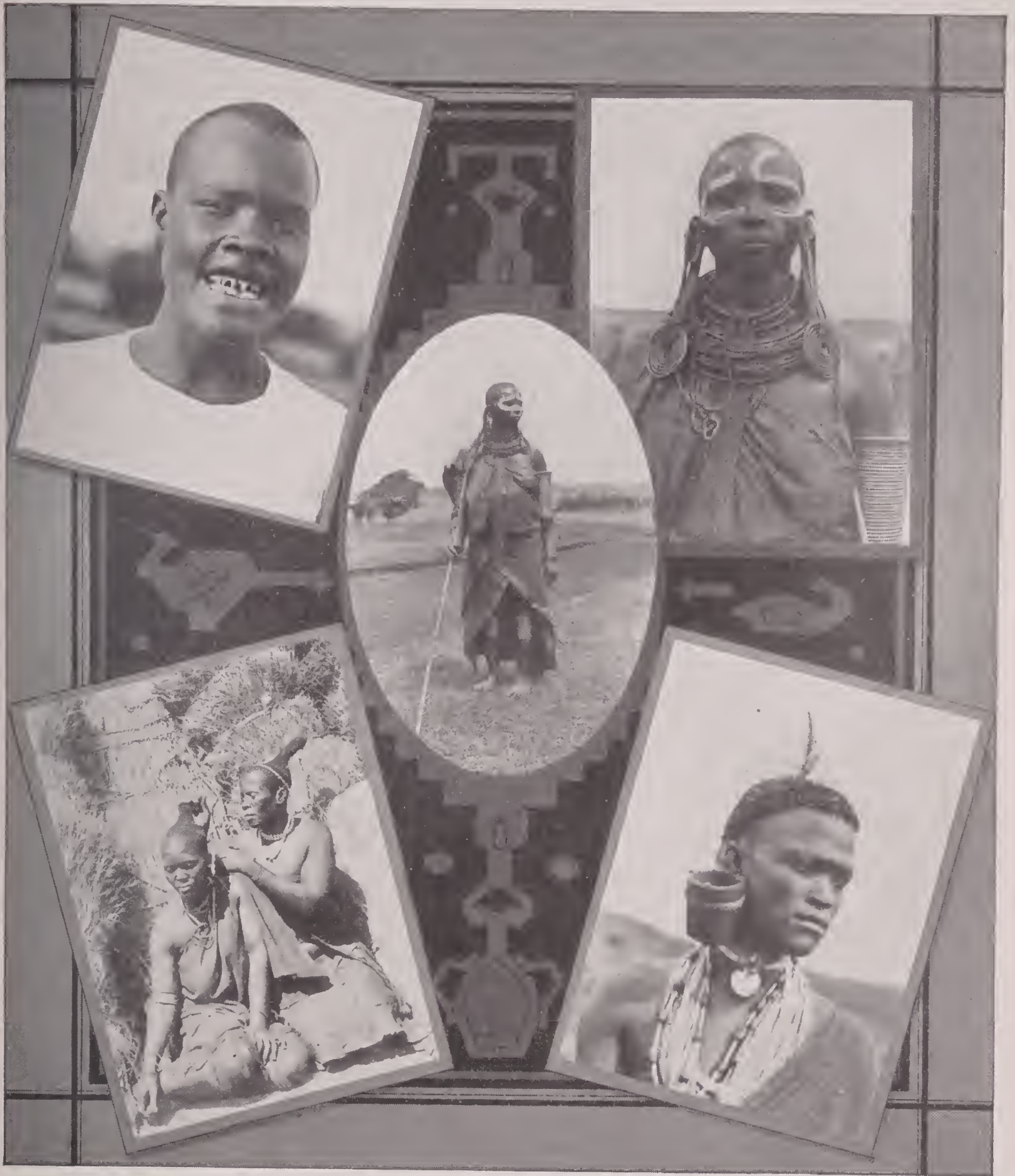
Before turning southward let us visit the famous African lakes. Perhaps the strangest of all is lonely Lake Chad, slowly drying up on the southern boundaries of the Sahara. At high water, when the Shari and Yo rivers bring their floods from the south and west, Lake Chad is about 150 miles long, but never more than 20 or 25 feet deep. The lake is stocked with fish, water-fowl, turtles of enormous size, and

FORTY MILES FOR TWENTY CENTS!



If you want to send a letter, in certain parts of Africa, you don't drop it into a mail box. You hand it to a young native like this one. He fastens it in the fork of a stick so that he won't forget it and so that the other natives will not interfere with him; for they know if they do they will get themselves into trouble with their British rulers. Then, with a spear in the other hand to defend himself from any wild animals that may attack him, he starts off at a jogging trot which will carry your letter some forty miles a day. For this service he will charge you the equivalent of twenty cents in our money.

SOCIETY NOTES FROM DARKEST AFRICA



You can see that all the people in this picture page are pretty much dressed up—all except the gentleman in the upper left-hand corner, but he belongs to the "smart set" too, as he means to show you by his teeth. You might suppose he had been neglecting the dentist, but it's just the other way around; his teeth have been filed that way on purpose. Teeth like that are the mark of a gentleman in the uncivilized Sudan. Not many years ago these natives were cannibals and ate human flesh. The Bantu tribes vary the fashion by filing the lower teeth.

The markings on the face of the woman in the center are not only supposed to make her beautiful, but show to which tribe she belongs. The brass or copper wire and rings she wears weigh from forty to sixty pounds. Notice also the "close up" of the head and shoulders of the same woman.

The man in the lower right-hand corner is wearing a small jelly jar in his ear, both because he considers it ornamental and because it is heavy and pulls his ear out of its natural shape. This is a good illustration of fashion in deformity, which has not always been confined to savages. His hair is given the proper color and consistency with a mixture of castor oil and red earth.

When the lady in the lower left-hand picture gets through dressing the other lady's hair it will stand out straight in the back just as hers does. This is accomplished by putting a wad of wool in the center and then binding the kinky hair very tightly around it.

contained in the Easy Reference Fact-Index at the end of this work

crocodiles, while the surrounding country is filled with game. Each year sees the desert encroaching a little bit more.

The Great Lakes Region

The other big African lakes form a group running north and south along the "Great Rift valley" or continental trough formed by the East Coast highlands. The greatest of these lakes is Victoria Nyanza (*nyanza* means "lake"), the principal feeder of the Nile River; it measures 230 miles at the widest point and, next to Lake Superior, is the largest body of fresh water on the globe. The Kagera River, the ultimate headstream of the whole Nile system, flows into it. Lake Victoria in turn flows into Albert Nyanza to the northwest, a lake about 100 miles long and 20 broad, which receives also, through the Semliki River, the waters of Albert Edward Nyanza, 100 miles farther south; the latter is about 40 miles in diameter.

Between Lake Albert and Lake Albert Edward, and east of the Semliki River, appear the snow-clad peaks of Ruwenzori, the famous "Mountains of the Moon," whose rumored existence gave rise many centuries ago to strange myths (*see Nile River*).

Directly south of Lake Albert Edward, the great Kirunga volcano with its mile-wide fiery crater divides the lakes which flow into the Nile from those which feed the Congo and Zambezi rivers. Greatest of these is Lake Tanganyika, the longest lake in the world, measuring 400 miles, which at high water flows into the Congo through the Lukuga River. Of the Zambezi lakes, Nyasa is the most noteworthy, for, besides being 340 miles long, it reaches in spots the extraordinary depth of 2,600 feet. Here must be mentioned the famous Victoria Falls of the Zambezi, nearly 400 feet high and a mile wide, one of the greatest cataracts in the world.

From Herodotus to Da Gama

Let us now approach South Africa by way of the sea. Herodotus, the Greek historian of the 5th century before Christ, relates that 100 years before his time Phoenician navigators in the employ of King Necho of Egypt sailed around Africa, hugging the coast from the Red Sea to the Mediterranean. If anything was learned on this early journey it was quickly forgotten, for map makers for 2,000 years afterward showed the continent ending at the "Mountains of the Moon." A new era dawned, however, when early in the 15th century Prince Henry of Portugal, called "The Navigator," devoted himself to finding a sea route to the East around the African coasts. His untiring efforts, carried forward after his death by others, led at last to the rounding of the Cape

of Good Hope by Bartholomew Diaz in 1488, and the successful voyage to India of Vasco da Gama in 1497-98. This achievement led a century and a half later to the Dutch settlement of Cape Town, in 1652, the first permanent colony in South Africa.

Traveling northward from the Cape of Good Hope, the country shows a strange resemblance to the Africa of the Mediterranean. The Nieuwvelt Mountains, the Great Karoo highlands, and farther to the east

the Drakensberg range, rise quickly from the coast, attaining an altitude from 2,000 to 10,000 feet. Passing through the high interior plateau or veldt, we reach the Orange River, the only large stream in lower South Africa. Beyond the Orange River, and midway to the Zambezi, lies the Kalahari desert, a stretch of waste land about 600 miles in diameter,

which in heat and barrenness is a small counterpart of the Sahara.

Fierce Natives Delayed Settlement

The animal inhabitants of the interior of South Africa do not differ greatly from those of the northern savannas. The native ostrich has been tamed to a large extent for the sake of its valuable feathers. The chief wealth of this region lies in its great diamond fields, centering at Kimberley, and its gold mines in the Johannesburg district, and farther north in Rhodesia. How these affected the history of this country is told elsewhere (*see South Africa*).

Together with the rugged nature of this territory, the fierce character of the natives delayed peaceful settlement. The Hottentots along the southwest coast were friendly enough, but the dwarf Bushmen beyond the mountains inspired terror in the later settlers, killing many with their poisoned arrows, and generally winning a reputation for great cruelty.

But the most formidable obstacle was raised by the powerful and highly organized Zulu-Kaffir state to the northeast. The Zulus, who form a branch of the great Kaffir family, are tall, vigorous, and intelligent. They quickly learned the white man's lesson, presenting none of the child-like simplicity found in most negro tribes, with the result that they not only opposed the settlers with arms, but were able to stir up political discord among the whites themselves. It was not until the British had been defeated in several fierce encounters that the power of King Cetewayo of Zululand was broken in 1879.

To complete the broad survey of Africa we must leave the continent on the east coast, sail 230 miles across the Mozambique channel, and land in Madagascar. This massive island, one of the four largest in the world, is 980 miles long and 350 miles across at its widest point. Except for its position it has little

NATIVE BLACKSMITH AT WORK



In Africa the village blacksmith doesn't stand, as he does in Longfellow's poem. He sits and he keeps a boy to blow the bellows for him. Some tribes do excellent work in iron.

in common with the rest of Africa. The Malagasy people, chief of whom are the Hovas, appear to be descended in large part from Malay or Polynesian stock. Their history and the story of European colonization is told elsewhere (see Madagascar).

Until recent years they were often cannibals. They still indulge in scar-tattooing and file the teeth of the upper jaw into points. Their natural weapons are bows and arrows, and they carry wooden shields. Witchcraft and fetishism have a strong hold upon

A "WALLED CITY" IN BRITISH EAST AFRICA



This doesn't look much like the walled cities that figure so prominently in the romantic days of knighthood, does it? Yet it is a walled city, although the wall is built of mud. Inside the wall is a native village. Such fortified villages in Africa are called "kraals." The wall has but one narrow opening. At night the cattle are driven inside to prevent their being killed by wild animals. The open space in the center of the village is for the cattle at night, and for cooking the family meals in the daytime.

Estimates of the native population of Africa today must necessarily remain vague, but the best authorities place the so-called blacks at 150,000,000, while the lighter peoples, north of the Sahara and scattered along the northeast coast, number about 20,000,000. The black population has decreased greatly since the advent of Europeans. The slave trade particularly made tremendous inroads, which may be judged by the fact that in North and South America alone there are today more than 20,000,000 people of African descent (see Negro; Slavery).

The Four Great Races of Africa

Due to the constant intermingling of tribes and peoples the greatest confusion of races exists, but it is possible to distinguish broadly four elements: the *Bushman*, the *Negro*, the *Hamite*, and the *Semite*. The *Bushman*, whom we have already seen in South Africa, although he is classed as a black has little relation to the negro. He is very short, and yellow of skin, and the shape of his skull and bones differs from that of his northern neighbors. The *Hottentot* is believed to be a cross between the *Bushman* and other African races.

The negroes who inhabit the great forests and the central and southern plateaus may be considered the true Africans in race and civilization. They fall into two great groups—the northern or Sudan negroes, occupying a wide strip from the Guinea coast (sometimes called Senegambia) eastward to the sources of the Nile; and the Bantu tribes, extending from the middle of the great forests downward, covering the southern horn of the continent. The first speak a great variety of distinct languages, while the Bantu tongues all resemble each other closely.

The Sudan negroes are mostly farmers, raising plantains, yams, and manioc; they dwell in rectangular huts and wear bark-cloth or palm-fiber clothing.

them, and they practice their heathen religion largely through secret societies.

The Bantus, on the other hand, are cattle-breeders as well as farmers, drinking milk, which is virtually unknown to the northern negroes. They build round huts and wear skin and leather clothing. They know how to smelt iron ore and to fashion iron weapons. They usually carry spears and hide-covered shields. Cannibalism appears to have been rare among them. Their religion is usually a form of ancestor worship, which in the dry regions of the south is mixed up with rain-making superstitions. When they file their teeth they prefer to work on the lower jaw.

When we leave the pure negro and go northward to the Mediterranean and eastward into the Nile valley and Abyssinia, the confusion grows, because almost everywhere the peoples called "Hamites" and "Semites" have mixed with each other, as well as with the negroes whom they enslaved at an early date. The Hamites, however, predominate. They include the Berbers of the Atlas region, who are of pure white race; the Kabyles and Tuaregs of the desert; the Fellahin (descendants of the ancient Egyptians); the Bisharin of the Red Sea coast; and the Gallas, Somalis, and Masai of East Africa. The Semites include, besides the various Arab tribes of north and northwest Africa, an important part of the inhabitants of Abyssinia. If Hamites and Semites are split racially, the vast majority of them are closely bound together by the common tie of the Mohammedan religion, the most powerful single influence in northern Africa (see Mohammed and Mohammedanism).

The history and description of Egypt and other countries of north Africa is too long and involved to be told here in detail. For these and other important states of Africa, consult the separate articles.

In the year 1875 less than one-tenth of Africa was under European rule. Today the small negro republic of Liberia, protected by the United States, and the ancient kingdom of Abyssinia, whose 300,000 square

missionary David Livingstone, who turned explorer and became a pioneer of trade and empire. In 1849 he crossed the Kalahari desert from south to north, and began his famous series of travels which made

WHERE HOUSES ARE BUILT LIKE GIANT HATS



Here is a view of a Kaffir kraal or village in South Africa. These famous "mushroom" huts are woven of tall grass with as much skill and perfection as many a product of a civilized hat factory. The grass stems are plaited and overlaid, and reinforced with ropes of vegetable fiber or strips of skin. The thick walls and domed roof are wind and rain proof. The doorways, generally very low, have ornamental friezes cut in the dried straw which denote the social position of its occupants. These round huts are peculiar to the Bantu tribes south of the great forest regions. The more primitive Congo and West Coast negroes build cruder dwellings, rectangular in form, with ridged roofs.

miles are cut off entirely from the sea, are the only spots which have not been taken over by European powers. This sudden and tremendous colonial expansion, sometimes called the "scramble for Africa," was the result of the great political and economic changes which swept over Europe in the middle of the 19th century.

The slave trade and the barter for ivory and gold which followed the Portuguese discoveries of the 15th and 16th centuries had done little to encourage colonization. Christianity, which had flourished so brightly in northern Africa during the early centuries of our era, had been swept away by the Mohammedan conquests of the 7th century, leaving only slender traces in Abyssinia and in the Coptic church of Egypt. The Turks, in turn, had overthrown Arab rule in the 16th century. Nowhere, except in South Africa and in a few Portuguese outposts on the east coast, had Europeans gained a foothold. In the 18th century Europe, engaged in constant warfare and busied with its own affairs, virtually forgot Africa.

But in the course of the wars with Napoleon and his allies, Great Britain took possession of the Dutch colonies at the Cape of Good Hope, and the slow awakening began. By agreement of the powers in 1836, the slave trade was abolished, and the period of great exploration opened.

Passing over Mungo Park, James Bruce, and many other great names of earlier days, we come to the

known the great waterways of the upper Zambezi and the southern lakes. In 1862 J. H. Speke reached a stream in central Africa which he followed through Egypt to the sea, being thus the first white man to read the riddle of the Nile. Paul du Chaillu, in 1865, found the pigmy negro races in the great forests. Six years before he had observed for the first time the giant gorilla, thus confirming the old Greek and Carthaginian legends about dwarf men and giant apes. The great hunter Frederick C. Selous began, in 1872, his 20-year travels, which did more than anything else to clear up the mysteries of South Africa.

But it remained for Henry M. Stanley, the great Anglo-American explorer, to set afire the European imagination with dreams of Africa. After a thrilling rescue of Livingstone in 1871, Stanley determined to explore the entire Congo region. Entering from the east coast in 1875, he reached the Lualaba, which had been mistaken by Livingstone for a branch of the Nile, and followed the river to the Atlantic Ocean on the west in 1877, proving it to be the Congo.

Two events of the greatest importance to Africa's future had taken place in 1869. The Suez canal had been opened, and diamonds had been found in South Africa at the junction of the Vaal and Orange rivers. These events, coupled with Stanley's great achievement, whetted the appetites of the manufacturing and trading classes of Europe.

THE HELPING HAND



Most heavy work among African natives is done by women, and here we see one laborer helping another with her pack. While the custom of letting women do the work may seem ungallant, it has advantages, for many a negro wife becomes more muscular than her idle husband, and rules her household by the right of might.

THE HAND OF CIVILIZATION IN AFRICA



The pictures on this page give a good idea of what civilization and the white man have done for Africa. For one thing they have put the fierce native Zulu in a policeman's uniform and set him to keeping law and order, instead of stirring up trouble as the Zulus used to do. Like an American policeman he carries a stick, which is used on those who refuse to obey. You will notice, however, that it has a heavy ball on the end of it. The native skulls are very hard and thick and the ordinary locust stick would make little impression on them.

This policeman belongs in Durban, one of the prosperous towns in Natal, South Africa. So does the rickshaw runner. The runner wears the horns as ornaments. The men who do this work are between 18 and 20 years of age and go from 20 to 30 miles a day.

Just above the runner is a picture of the native quarters of Mombasa in British East Africa and above, to the right, is a view in the residence portion of Zanzibar; while in the lower left-hand corner is shown one of the business streets. The beautiful view of Cape Town and Table Bay was taken from an airplane. Cape Town is a very modern city, as you can see by the view on Adderly Street.

The city is built upon a plain flanked on every side, except the bay, by mountains. Behind the city to the south is Table Mountain, over three thousand feet high, and extending for a distance of two miles. You can see it here as you look up Adderly Street. On Adderly Street are the custom house and railway station, and the post and telegraph office. In Cape Town, as in England, the government takes charge of your telegraph messages as well as your letters. The suburbs of Cape Town are famous the world over for their beauty, standing as they do in a kind of amphitheater overlooking the broad plain on which the city is built.

contained in the Easy Reference Fact-Index at the end of this work

Leopold II, king of Belgium, a shrewd business man, fired the gun which started the race for Africa, when he made known his personal project to form the Congo Free State and exploit the wealth of the great forest region.

The Scramble for African Territory

Germany, united and aggressive after its victory in the Franco-Prussian war, felt a need for colonies and leaped into Africa as the only opening left. Great Britain, already in control of South Africa, and France, in possession since 1830 of Algeria, were roused to their opportunities elsewhere on the continent. Portugal, stirred from her lethargy, began to polish up ancient claims. The big scramble was on.

King Leopold and the French clashed in the Congo. Germany blocked England in East Africa. England blocked France in the Sudan. Portugal obtained England's support for her claims at the mouth of the Congo, bringing a loud chorus of protests from France, Germany, and King Leopold. Italy seized the Red Sea coast of Abyssinia. Every nation involved was sending into the interior messengers armed with blank treaty forms, which they induced native chiefs to sign. Many of these chiefs signed cheerfully for every one who came along. Indescribable confusion soon reigned.

To put an end to the uncertainty, a conference of the powers was called in Berlin, in 1884, which laid down rules under which annexations should be valid. It was agreed that each nation should notify other nations of their projects for colonization, outlining the territories for which they intended to be responsible and where their "sphere of influence" was to extend.

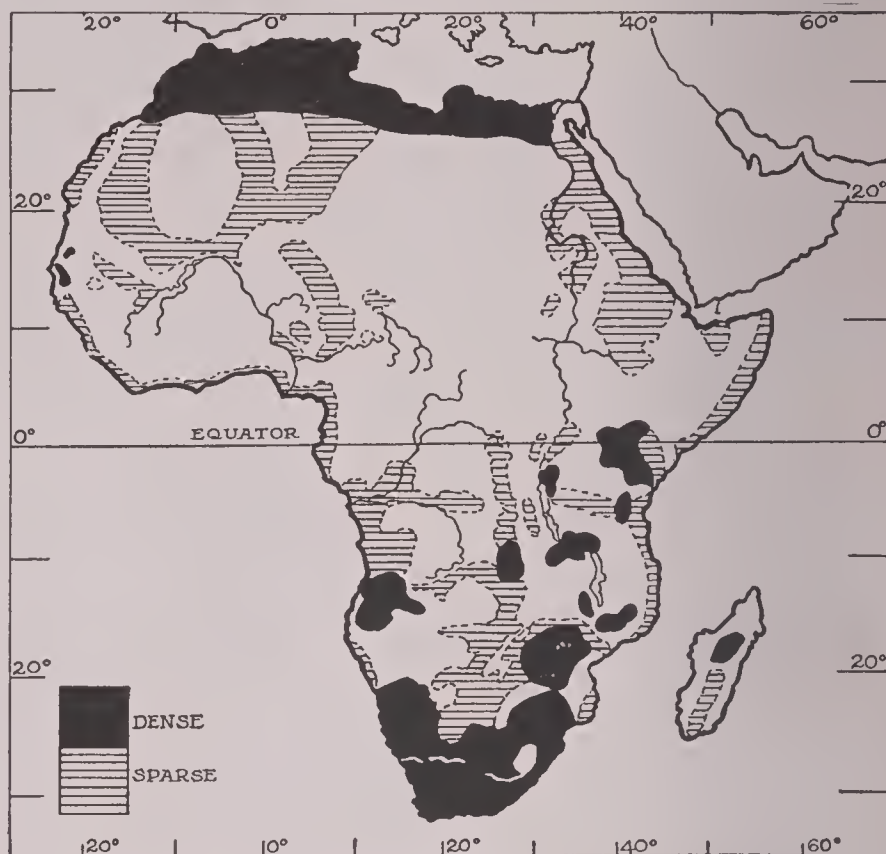
The next 15 years saw the main partition of Africa concluded after war had several times been narrowly averted. France obtained control of northwest Africa and the north bank of the Congo, as well as the island of Madagascar. England clung to Egypt (where she had been forced to intervene in 1882), consolidated her possessions in South Africa, opened a large new colony in East Africa, and established herself at the mouth of the Niger River. Leopold took over the great Congo basin as the Congo Free State (transferred to Belgium as a colony in 1908). Portugal retained Angola in the west and Mozambique in the east. Italy, after a disastrous defeat by the Abyssinian forces, held a small strip on the Red Sea and a large slice of Somaliland; to these Tripoli was added after a war with Turkey in 1911-12.

Germany succeeded for a time in defeating England's desire for an all-British strip from Cape Town to Cairo by thrusting in a broad wedge in East Africa. The Berlin government also obtained a large section of southwest Africa, north of the Orange

River, a slice of the Congo region called Cameroon, and a thin strip on the Gold Coast named Togoland. During the World War, however, these possessions were taken over by England, France, Belgium, and Portugal and redistributed.

The detailed political divisions of Africa at the present day are shown on the accompanying map. Under European guidance the immense resources

WHERE THE LIGHT SHINES IN DARKEST AFRICA



The portions of Africa settled by white people are shown in the accompanying map. The regions most densely populated are indicated in black and the more sparsely settled regions in the lighter shading. In many cases the portions indicated as being less densely settled are mere trading or missionary stations. In the regions indicated by white spaces no white people live at all, and in the desert regions neither whites nor blacks, except where there are oases.

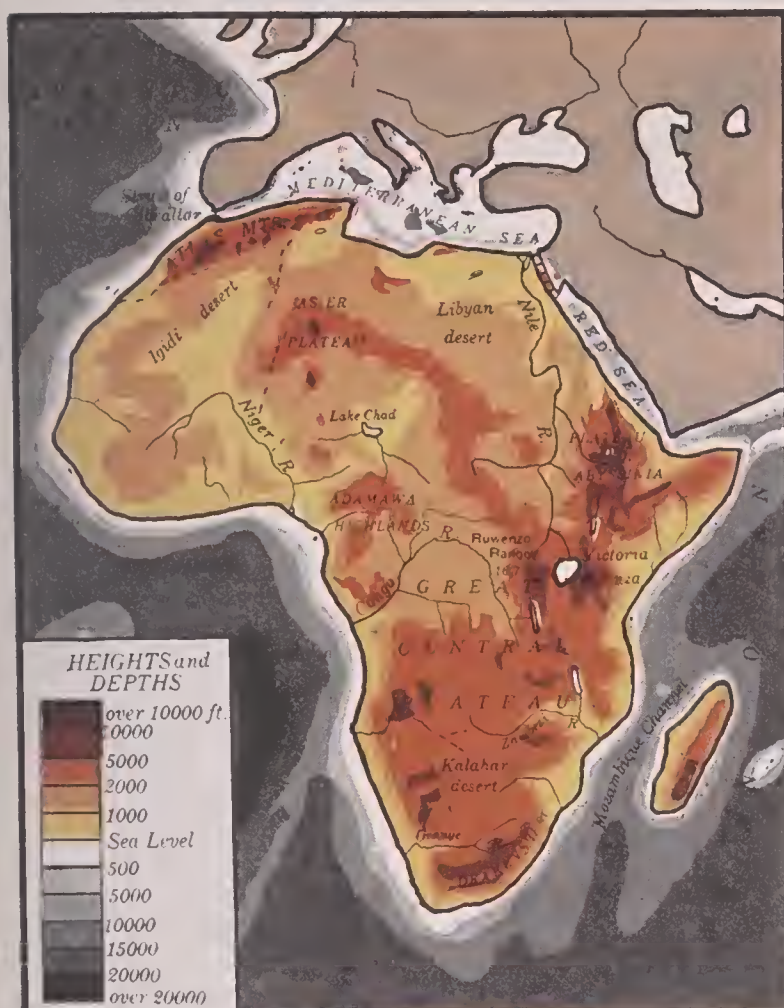
of Africa are being rapidly developed, and the natives are slowly being trained to civilized life. Always rich in jungle products, such as india rubber, palm oil, teakwood, ebony, mahogany, gum arabic, etc., the land is growing more fertile under the plow. The cultivated products include cotton, coffee, copra, corn, wheat, sugar cane, rice, tea, tobacco, indigo, fruits, cloves, and drug-yielding plants. The climate of Africa offers every extreme from the drought of the Sahara, where there is virtually no rain, to the Congo coast where 390 inches fall annually; and from the cold of the mountains to the heat of the central forests; so there is virtually no tree or plant which cannot find a home in its soil.

Africa's Promising Future

Agriculture is being pushed, especially on the great savannas, and, wherever the tsetse fly can be exterminated, European breeds of cattle are being imported and raised.

Africa is of course rich in animal resources. Ivory is still the most important of these, although the

THINGS YOU SHOULD KNOW ABOUT AFRICA



The development of every country is largely due to natural conditions. The most important of these natural conditions—physiography and rainfall—are shown in the first two of these four maps of the great continent of Africa. In the next two are presented the facts with regard to vegetation and density of population, which are largely the result of the climate and physiography of the country.



elephant herds have been practically exterminated near the settlements. The supply of skins, wool, and hair, ostrich feathers, etc., continues large.

The immediate future of Africa lies, however, in its mineral products. Twenty-five per cent of the world's gold is mined there, and 80 per cent of the world's diamonds. Tremendous copper fields exist in South Africa and in the south Congo basin. Many of the colonies are already developing coal fields sufficient for their own use, while the supply of iron ore is apparently limitless. Petroleum is found in Somaliland and Egypt, tin in the Niger valley, lead and silver in Morocco.

Transportation facilities are rapidly developing. Although there are only four streams—the Nile, the Congo, the Niger, and the Zambezi—which offer really good facilities for inland navigation, these are of immense importance. On all the great lakes steamers have been carried overland and launched.

Lions Still Roar as Trains Flash By

The French and British are particularly active in extending the railway systems. One may take a sleeping car in Cape Town and wake up some morning in the Belgian Congo. On the famous Uganda Railway from Mombasa to Lake Victoria, travelers can lie in their berths and occasionally hear the lions roar, as they stop at night at some wayside station, and during the day the long neck of a giraffe may sometimes be seen craning from the bushes toward the "iron horse." The Nile rail system is gradually extending south of Khartum to meet the railway from South Africa, and thus complete the Cape-to-Cairo route dreamed of by Cecil Rhodes (see Rhodes, Cecil). From the network of railways in Algeria and Morocco, the French are projecting lines across the desert to link up with those in Senegal, Dahomey, and British Nigeria. The Portuguese have completed more than half of a railroad to link their east and west coast possessions. The telegraph clicks and the wireless sputters in the great forests where Livingstone and Stanley so often lost their way; and French, Italian, and British airplanes soar above the burning sands of the Sahara, carrying mail to distant outposts.

Finally, schools and factories are springing up side by side. Tribal wars are rapidly becoming a thing of the past. The natives are becoming peaceful traders and farmers and are even in some sections winning the right to vote. The day of the savage is indeed ended in Africa.

For additional information see the following articles:

Abyssinia	Egypt	Sahara
Alexandria	Gold	South Africa
Algeria	Ivory	Stanley, Sir Henry
Boer War	Johannesburg	Tanganyika, Lake
Cairo	Liberia	Tripoli
Cape of Good Hope	Livingstone, David	Tunis
Cape Town	Madagascar	Victoria Falls
Congo River	Morocco	Victoria Nyanza
Congo State	Niger River	Zambezi River
Diamond	Nile River	Zanzibar
East Africa	Rhodes, Cecil	

AGASSIZ (*ăg'a-si*), LOUIS JEAN RODOLPHE (1807–1873). At the age of 21 this celebrated naturalist wrote to his father: "I wish it may be said of Louis Agassiz that he was the first naturalist of his time, a good citizen, and a good son, beloved of those who knew him." All this and more came true. He became not only the greatest authority of his day on



LOUIS JEAN AGASSIZ

zoölogy and geology, but a great teacher and leader, who had the power of inspiring other men with his enthusiasm for science. His sunny disposition and his great-hearted sympathy and generosity endeared him to all those who came close to him; and his is among the most distinguished names in both Switzerland, his native country,

and America, the land of his adoption.

The Boy Foreshadows the Man

The son of a pastor, Louis Agassiz was born in the little Swiss village of Môtiers, not far from Lake Neuchâtel. As a boy he loved birds and beasts, fishes and insects, and delighted in collecting specimens and searching for new creatures. He studied medicine at the universities of Zurich, Heidelberg, and Munich. But his greatest enthusiasm was for zoölogy, and he welcomed the opportunity to devote himself to this pursuit, when in 1829 he was invited by a well-known naturalist to edit a work on Brazilian fishes. This was followed by an extended investigation of European fishes, in which he studied not only the living specimens, but the fossil fishes preserved in the rocks; and this in turn led to an interest in geology. He spent a summer in a hut on the edge of a glacier, where, in the midst of dangers and privations, he studied its action. His subsequent studies along this line helped to establish the theory, now universally accepted, that at different times the greater part of Europe was covered by these vast sheets of ice.

Agassiz had become professor of natural history at Neuchâtel in 1832 and remained there until 1846, when he came to America to deliver a series of lectures in Boston. The following year he accepted the chair of zoölogy and geology at Harvard University. The ties which he formed in America and the opportunities offered for scientific research led him to refuse tempting offers to return to Europe, and to remain here until the end of his life. In addition to teaching he did considerable writing, delivered

popular lectures on scientific subjects, and engaged in scientific expeditions in various parts of the United States and Brazil. He was the founder of the great Museum of Natural History at Harvard, now famous as the Agassiz Museum. When urged to turn to financial profit his great scientific knowledge, he impatiently replied that he "had no time to make money."

Studying Science from Nature's Books

A few months before his death, Agassiz carried out a long-cherished idea in establishing a summer school of science on the island of Penikese, in Buzzard's Bay, off the southeast coast of Massachusetts. This was the first school for studying science directly from specimens and in close contact with nature. It made vital and attractive the study of natural science, and through the young men who there gained inspiration, he helped to lift science teaching to a higher plane.

Agassiz died at Cambridge in 1873, and on his grave were placed a boulder that came from the glacier near the spot where his hut once stood, and pine trees sent from his old home in Switzerland. "The land of his birth and the land of his adoption are united in his grave."

His son Alexander (1835-1910), also a distinguished naturalist and writer, was, from 1874 to 1897, chief curator of the museum of comparative zoölogy which his father had founded.

Louis Agassiz's most important American publications are: 'Methods of Study in Natural History'; 'Geological Sketches'; 'The Structure of Animal Life'; 'A Journey in Brazil' (with his wife, Elizabeth Agassiz); 'Contributions to the Natural History of the United States' (only four volumes of the ten planned were completed).

AGAVE (*a-jā've*). The best known species of this remarkable and beautiful family of plants, the American aloe, is commonly known as the century plant, through a mistaken idea that it blooms only when it has reached the age of 100 years. As a matter of fact the time of blooming depends entirely upon the vigor of the individual plant and the conditions under which it is grown. In warm countries where the growth is rapid, flowers appear in a few years, while in colder climates the plant sometimes requires from 40 to 60 years to reach maturity.

Various Uses of the Century Plant

A native of Mexico and Central America, the century plant is widely cultivated for ornamental purposes, and in Spain, Portugal, and Italy is often

A CENTURY PLANT IN BLOOM



This picture shows the agave or century plant in bloom. The flower shoot grows to a height of 30 feet with side branches and bearing the flower clusters as shown. As you see by the article, the agave has almost as many uses as it has flowers.

used as a fence. The leaves—thick, fleshy, and spiny-toothed—form a sort of rosette from the center of which springs, at the time of flowering, a tall branched stem with erect greenish-yellow clustered blossoms. When the plant has flowered the leaves die down, but suckers are frequently produced from the base of the stem which become new plants.

The American aloe and numerous other species of agave are very useful plants in Mexico, where they are grown as a regular farm crop. The sap when fermented produces the national beverage, *pulque*, and distilled it forms a spirit called *mescal*. The leaves are used as fodder, and rope, cord, bagging, and matting are manufactured from their fiber. One variety yields the sisal hemp of commerce. The juice of the leaves will lather in water, like soap, and is much used in washing.

Scientific name of American aloe, *Agave americana*. Leaf-stem stout and short. Leaves long, thick, pointed, with spiny margin; in them is stored nourishment for the effort of flowering. Flower-stem often 20 feet or more in height, much branched. Flowers erect, clustered; tube of corolla narrowed in the middle; stamens extending beyond corolla.

AGINCOURT (*ā-zhǎn-kōōr'*). The third great victory of the English over the French in the Hundred Years' War was won Oct. 25, 1415,

at the village of Agincourt in northern France. The young king, Henry V, had recently succeeded his father, Henry IV, on the insecure Lancastrian throne of England, and resolved (as Shakespeare phrases it) "to busy giddy minds with foreign quarrels" by reviving the English claim to the French throne. Landing in Normandy, he found his way blocked by a great French army 20 miles northeast of Crécy, the scene of the first great triumph. The French knights, who were four times as numerous as the English—mainly foot soldiers—foolishly dismounted and advanced in their heavy armor through the deep mud of the newly plowed fields. Three times they came on, in the narrow defile between two woods, and three times the clouds of arrows let fly by the skilled English archers forced them to retire. The defeat turned into a rout. More than 10,000 French were killed, including many princes and nobles, while the English lost only a few hundred. This decisive defeat, with Crécy and Poitiers, proved the superiority of the English longbowmen over the crossbowmen and paved the way for the overthrow of the dominance of the armored knight, which was the military basis of feudalism. (See Hundred Years' War.)

How the FARMER FEEDS the WORLD

AGRICULTURE. The farmer is a modern Atlas, bearing the world on his shoulders. To him we all look for our daily bread. If he were to lay down his burden, all other industries would stop and mankind would go back to primitive conditions.

Once upon a time, many thousands of years ago, there were no farmers. Men depended upon fruits and nuts, fish and game, and other foods they could get without cultivation.

Famine was their most dreaded enemy, for the wild foods often failed. Men wandered from place to place in search of food and fought with their neighbors for a share when it was found. There were no settled communities, and so there was little opportunity for progress of any kind. But when at last men learned to care for flocks and herds, and plant seeds, food became more abundant and life became easier. Communities sprang up in which some of the workers provided food for all, while the other workers applied themselves to various handicrafts, trades, and arts. From such a division of labor, based on agriculture, have grown all the many activities that make up modern civilized life—the trade and commerce of the world, its arts and sciences, and the wonderful industrial life of this 20th century.

But though agriculture has been practiced since the late Stone Age, more progress has been made in the last two centuries than in all the thousands of years preceding. If a farmer of the days when George Washington was a boy could come to life and visit an up-to-date farm of today, he would be as astonished by the changes wrought in the past two centuries as if he had discovered a new world.

From Crooked Sticks to Gang Plows

With the wonderful labor-saving inventions at his command, the farmer of today can cultivate a thousand acres as easily as Washington's father cultivated fifty, or the primitive husbandman cultivated one. A stick was the first hand tool used to scratch the surface of the ground before planting, and a forked stick, held in the ground by the plowman while the oxen dragged it ahead, was the first plow. Improvement was very slow, and after thousands of years farmers were still using clumsy wooden hoes, wooden plows, and tools of similar crudeness. Not until the industrial revolution of the late 18th and early 19th centuries put keen-edged, strong, well-

WHEN the roosters start crowing before daybreak on the farms of the United States, they blow the factory whistles for the greatest industry in the world. The steel industry, the oil trusts, the railroads—these are not "big businesses" when compared with the great farm factory. All the gold and silver mined since Columbus discovered America would not buy the farms of this country alone. One worker in three in the United States is a farmer, and there is more money invested in agriculture than in all our great manufacturing industries and transportation systems combined. The value of the farm products evenly divided throughout the year would make a millionaire every half-hour of the day and night. And the money received for just eggs and poultry would pay in a year for the building of two Panama Canals. In the article which follows you will read something of the history of this greatest of industries, from the days when men scratched the soil with a crooked stick to the present, with its tractor-drawn plows and giant threshing-machines.

shaped tools in the hands of the farmer was any great advance made.

But the period of greatest progress has been since 1850, when American ingenuity has devised complicated machines for saving human labor in virtually every farm operation. What a contrast between the crooked stick with which the ancient Egyptians plowed, and the modern gang plow, turning 10 to 20 furrows at a time, drawn by a powerful tractor! And following

the gang plow across our fields come drags and disk harrows—also in gangs—and seeders and corn planters.

In the growing season the walking cultivators and sulky cultivators greatly lessen the labor of the "man with the hoe." Later in the year, mowers, hay tedders, hay rakes, and hay loaders go to the hay fields; and the hay fork stores the crop away in the barn or the hay press bales it for storage and shipment. To the corn fields go the corn cutters and binders; and husking machines, stalk cutters, and ensilage cutters prepare the crop for winter feeding. And to the grain fields go the reapers, binders, or harvesting machines, instead of an army of laborers with sickles or cradles. The modern threshing machine with a few laborers accomplishes in two or three days work which took all winter on the threshing floor with the hand flail.

How One Man Does the Work of Twenty

To show what these astonishing machines mean to the farmer, experts have calculated that the farmer of today can accomplish twenty times as much in his labor time as the farmer before the Civil War. For example, it takes only half an hour now to sow a quantity of grain that used to require ten hours. A job of harvesting that took nearly 47 hours can now be done in one hour. Corn can be planted more than ten times as fast and husked twenty times as rapidly. The mowing machine does more in one hour than the scythe would do in seven, and the potato planter multiplies the efficiency of a man with a hoe by eight.

Other modern equipment for the farm includes the cream separator, feed grinder, manure carrier and spreader, circular saw, stump puller, and a score of others. Many of them are operated by the gasoline engine or tractor at a great saving of time and labor. Gasoline engines pump the water on the modern farms, and very often local electric lighting systems are installed.

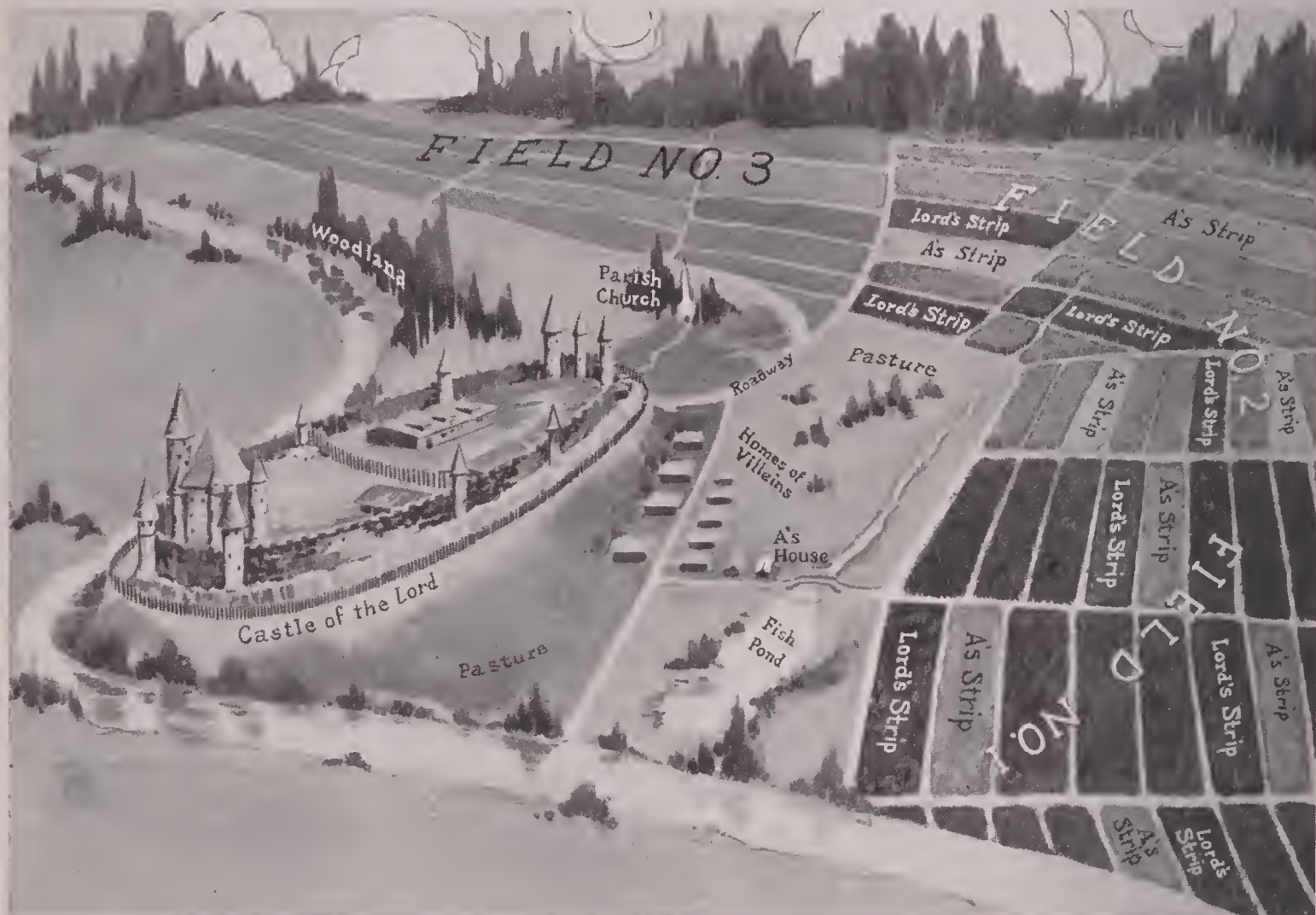
The United States has led in both the invention and use of farm machinery. The great stretches of fertile soil opened up to settlement in this country and the scarcity of labor demanded labor-saving and time-saving equipment for the farm. The invention of the

thanks to such mechanical triumphs as these that the American farm leads the world in production proportionately to the number of men employed.

Wonders Accomplished by Breeding

Not only the processes, but even the plants and

HOW FARMING WAS CONDUCTED IN THE MIDDLE AGES



Here we have a bird's-eye diagram showing a lord's castle and village, with its woodlands and pasture, and the "three-field system" of intermixed holdings. The house of a typical peasant or "villein" (whom we will call "A") is shown in the village, with his scattered acre-strips, separated by unplowed turf, in two of the three fields. The lord's "domain," which his peasants tilled for him, was similarly scattered, as were also the holdings of the other peasants. Each year one of the three fields was plowed but allowed to "lie fallow" or unplanted, in order that the soil might recover its fertility. This wasteful system held the agriculture of Europe in its grip for a thousand years.

cotton gin by Eli Whitney, at the close of the 18th century, brought increased prosperity to the farmers of the South. Two Americans, Charles Newbold and Jethro Wood, early in the 19th century invented the cast-iron plow, which took the place of the weak and cumbersome iron-tipped wooden plow of colonial days. After the middle of the century this was superseded by the chilled-steel plow invented by James Oliver. As the population increased, the "prairie schooner" and later the railroads carried the pioneers on into the boundless West. Vast stretches of level prairie land were waiting to be turned into the great grain fields of the world, but harvesting the crop in the short harvest season by hand labor was an impossibility. Cyrus H. McCormick made the first successful reaper in 1831, and today powerful tractors draw gangs of three to five harvesting machines across these western fields, harvesting 100 acres a day with less labor than it takes to cover one acre by hand. It is

animals of the modern farm are different from those of early days. From a few wild grasses, plants, and trees, man has obtained all of his valuable cereals, vegetables, and fruits; and the taming of wild fowl and animals has given him flocks and herds. Cultivation and breeding continued for many centuries produced varieties of plants and animals very superior to their wild ancestors. But here, too, modern science has conferred incalculable benefits on the farmer, teaching him how to develop new varieties and to improve the quality of plant and animal products in a comparatively short period of time.

Horses are bred, for example, either for speed or draft purposes. Many different breeds of cattle have been developed, some for better beef, others for greater milk production. The improved dairy cow will give fifteen times as much milk as the scrub cow, which gives barely enough to sustain one calf for a few weeks. The farmer is feeding hogs that will put

WHY THE FARM IS THE GREATEST OF ALL FACTORIES

The annual production of apples, oranges, and peaches —



This Unit

\$100,000,000

← equals →

one year's production of iron ore — plus \$200,000,000



The annual output of poultry, and honey



← equals →

the entire yearly production of all of America's oil wells — plus \$250,000,000



The live stock, supplied by the farms in one year



← equals →

the annual output of automobiles and farm implements—plus \$350,000,000



The yearly crop of corn and wheat



← equals →

the total yearly earnings of America's railroads — plus \$750,000,000

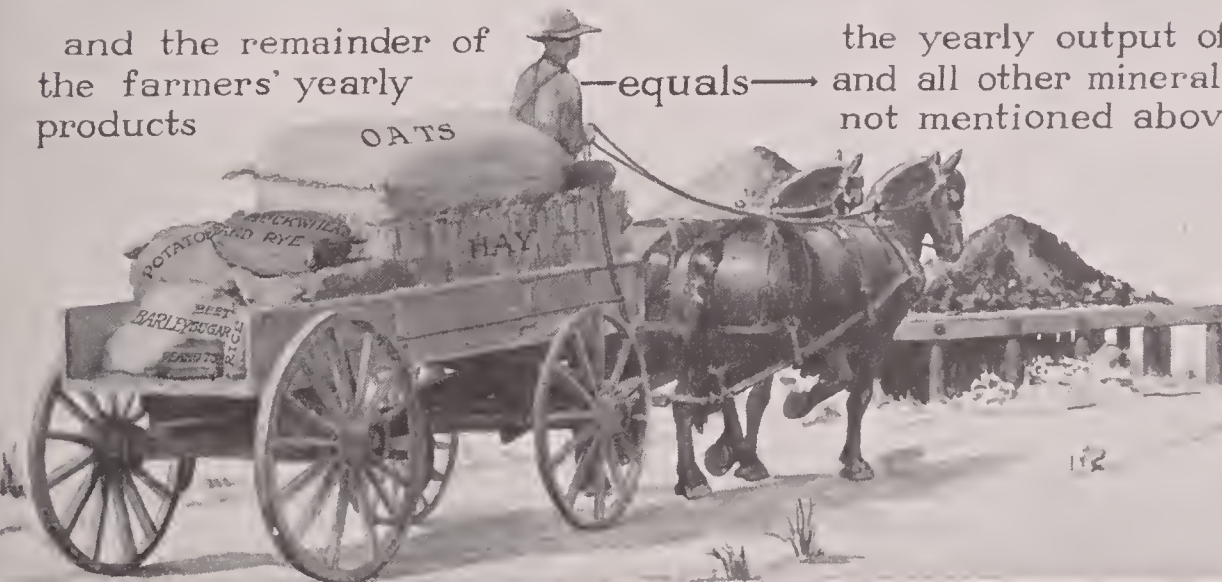


and the remainder of the farmers' yearly products

OATS

← equals →

the yearly output of coal and all other mineral products not mentioned above



The value of the products of the farm—the great factory where our food is made—is so much greater than that of any other industry in the world that it is difficult for the mind to grasp the fact. In this series of pictures the leading products of the farm are shown on one side of huge pairs of scales, and balanced against them are the products of other great lines of industry. In the first, for example, you see that the apples, oranges, and peaches grown each year exceed in value the year's production of iron ore by two hundred million dollars, as indicated by the two weights alongside the iron ore added to make the values balance. And so with other farm products shown on the different sets of scales and in the farmer's wagon. In all these pictures the relative value of the different products is indicated by their size; that explains why the apple is so much bigger than the orange, the pig almost as big as the cow, the egg bigger than the hen that laid it.

contained in the Easy Reference Fact-Index at the end of this work

STILL CLINGING TO CAMELS AND THE CROOKED STICK



The British administrators in Egypt have tried to introduce modern methods in farming, but the natives, as you can see by this picture, often do things in the old way. The camels hardly cling more closely to the ancient customs of camels than do these people of the changeless East, the Egyptians, in their way of doing everything, including the cultivation of the soil. The water in the background is the Nile, which annually fertilizes the fields of Egypt. The ropes on the backs of the camels are for hauling and are kept there so that when the farmer gets through with his plowing he won't have to trouble himself to harness the camel for the next piece of work. Buffaloes are even more largely used as draft animals than camels. The plow, as you see, is the ancient crooked stick, sharpened to a point, which was used in the days of the Pharaohs. Only the tip is shod with iron.

on weight much more rapidly and will produce many times as much bacon or lard as would the razorback or wild hog. Some sheep are bred especially for their mutton, others because of the quantity and quality of their wool. Hens belonging to the best-laying breeds produce an average of 120 eggs a year and prize winners have produced as high as 314 eggs

THRESHING NEAR AN EGYPTIAN VILLAGE



The methods of threshing among the natives in Egypt are just as primitive as their methods of plowing. A sledge loaded with stones is drawn by oxen over the wheat spread out over the ground, so crushing out the grains. Boys about twelve years old, like the one in the picture, usually do the driving. The rake in the foreground is, like the thresher, home-made. On the roofs of the houses in the rear are pigeon cotes. All Egyptian farmers have hundreds of pigeons for family use and for sale; and many of them breed fancy pigeons.

a year although the wild fowl would lay only 12 or 13. Scientific breeding and care have brought about many other wonderful changes, and no one can put a limit to the miraculous results still to come.

So too with plants. Careful selection of seed, breeding of new and improved varieties, and budding and grafting have done wonders. Potatoes have been selected to produce good-sized, regular-shaped tubers with smooth skin, growing a larger number to the hill.

From the wild apple with its small sour fruit like crab apples, over a thousand varieties have been developed with various qualities of size and flavor. In place of the tiny acid grapes full of seeds, we now have the large and luscious Concords, Catawbas, and Niagaras, with few or no seeds. The yield of the grains has been increased, and special types have been developed, such as drouth-resisting wheat, beardless barley, and corn that will mature in the short season of the northern states. Even the makeup of the grain has been changed to produce larger proportions of protein, starch, fats, or sugars, to better serve a particular purpose.

Agricultural chemistry has been one of the chief factors in this progress. By its aid we learn what



By the native farmers wheat is still winnowed on the Mount of Olives and throughout Palestine just as it was in the days of Christ. With his crude wooden fork the thresher keeps tossing and re-tossing the grain and chaff into the air until the wind has carried the chaff away.



plant foods are present in a particular sort of soil and what kinds and quantities of fertilizers should be used in improving poor soils. Stock feeds are analyzed to determine their values.

Veterinary science has greatly reduced the loss from disease among farm animals, and a study of plant diseases has cut down the loss from blights, rusts, smuts, and other diseases and parasites attacking plant life. Entomology contributes its share by studying the life of insects to determine which are helpful or harmful to the farmer, and how to encourage the helpers and curb the pests.

In the United States the importance of taking advantage of these various means of increasing the farm production of the nation is recognized by the national and state governments. In addition to the Department of Agriculture at Washington, agricultural experiment stations and agricultural colleges have been established in every state in the Union to work for better farming. These agencies help the farmer by distributing improved seed, by conducting experiments which often lead to great improvements in methods of farming, and by distributing information on all subjects of practical interest to the farmer. Many counties have farm agents who go directly to the farm upon request and conduct demonstrations of improved methods. Agriculture is taught in the public schools; and corn, garden, pig, and poultry clubs organized among boys and girls have been the

means of distributing information and demonstrating its value in many farm communities.

But great as is the progress that has been made, it has little more than pointed the way to the greater things that may be accomplished. For although the United States is leading all Europe in the total production of its farms, the yield per acre is very much lower. The difference is largely due to the fact that in the older countries labor is more abundant and the farms are small and intensively farmed; but it is entirely possible to double the yield in this country by more attention to selection of good seed, and by raising only the improved varieties and types peculiarly fitted to climate and conditions.

The United States is particularly fortunate in having a great variety of climate and other

conditions which makes it possible to raise a correspondingly great variety of products. The early settlers brought with them wheat, millet, timothy, clover, alfalfa, and other products from the Old World, and their farm animals—horses, cows, sheep, swine, and even chickens, ducks, and geese. Turkeys, however, and three important crops—corn, potatoes, and tobacco—as well as tomatoes and pumpkins, were gifts of the New World to the Old. While corn is still our most important farm crop, the adopted vegetation of the Old World flourishes in all parts of our land. The introduction of new varieties from other countries is still going on. A fine rice growing in

FEEDING THE FIELDS THAT GIVE US BREAD



Every intelligent farmer realizes that he must feed the fields if he expects the fields to feed him, and is very careful about the use of fertilizers. This picture shows a manure-spreader at work. A web runs to a rapidly whirling toothed cylinder in the rear of the cart, and in this way the load is gradually worked out and scattered evenly and to a short distance on each side as the cart moves along. As you see, this farmer is using a slack winter day to make ready for spring planting.

PREPARING THE SOIL FOR THE SEED



This twenty-horsepower tractor is used in preparing the soil for the seed. While the knife-edged wheels of the disk harrows cut the soil and throw it up into little ridges, the broad rollers in the rear, called "soil pulverizers," run over these ridges and crush them down. America leads the world in the invention and use of labor-saving agricultural machinery.

contained in the Easy Reference Fact-Index at the end of this work

Louisiana was brought from Japan. A variety of wheat which has flourished for centuries in the arid lands of Asia Minor and Russia makes a marvelous growth in the dry lands of the United States. A seedless grape was brought from Italy, the olive tree from Spain, a hardy peach from China, and the fig tree from Smyrna. Special agents from the Bureau of Agriculture have penetrated to odd corners of the world remote from civilization, often braving discomfort and danger, to discover new varieties of grains, fruits, trees, and flowers suitable for our land. They have sent back to this country a precious collection of roots for transplanting, buds for grafting, and seeds of different kinds. As a result, Chinese elms are growing on the plains of the Dakotas to furnish windbreaks for that treeless region, and the ash from Kashgar grows on the alkali soil of Nevada. The peach growers of California are using the root of a wild Chinese peach which is peculiarly resistant to drouth and alkali soil. The Tangsi cherry now growing in this country is the earliest to ripen by a week or ten days; and in California an orchard of the Chinese jujube has been planted which bears a fruit as delicious as the Persian Gulf date.

Farming Now a Profession

And what has happened to the farmer while all these changes have taken place? The new farmer is no longer a careless and ignorant hoe-man, blaming his failures to a "bad year." He does not laugh at the idea of going to school to learn to farm, as did the farmers of only a few years ago. And he no longer works from sun to sun merely to keep himself and family from starvation—nor does his wife. For improved machinery and the creamery and cheese factory have taken much of the drudgery of farming from the shoulders of the farm housewife as well as the farmer.

Farming is today a profession—a business counting its returns in millions; and the farmer who has been ready to profit by new inventions and the new lessons of science is earning the rewards of the successful business man. His farm buildings have increased in size and convenience. He rides in his automobile and enjoys such conveniences as the electric trolley, telephone, and daily mail, and his family enjoys many of the social and educational advantages enjoyed by his city friends.

Farming in Egypt and Babylonia

Wherever husbandry has been in highest esteem, there has been found a people advanced in civilization. Apart from the present-day advantages contributed by agricultural chemistry, new and improved machinery, and modern transportation facilities, the husbandmen of some of the nations of antiquity were in many essentials so advanced as to bear comparison with those of today. The ancient Egyptians practiced irrigation and crop rotation, and even the artificial incubation of poultry was not uncommon. The people of Assyria and Babylonia also raised vast cereal crops by irrigation.

Palestine afforded an early example of intensive farming, where small holdings were the rule. The limited farms, we learn from the Old Testament, produced abundantly, and their fertility was maintained by mixed husbandry and the application of manures. The ancient Romans were the foremost of their time in solving problems of irrigation, tillage, and fertilization. Columella, Cato, Pliny, and others taught many of the modern principles of scientific farming.

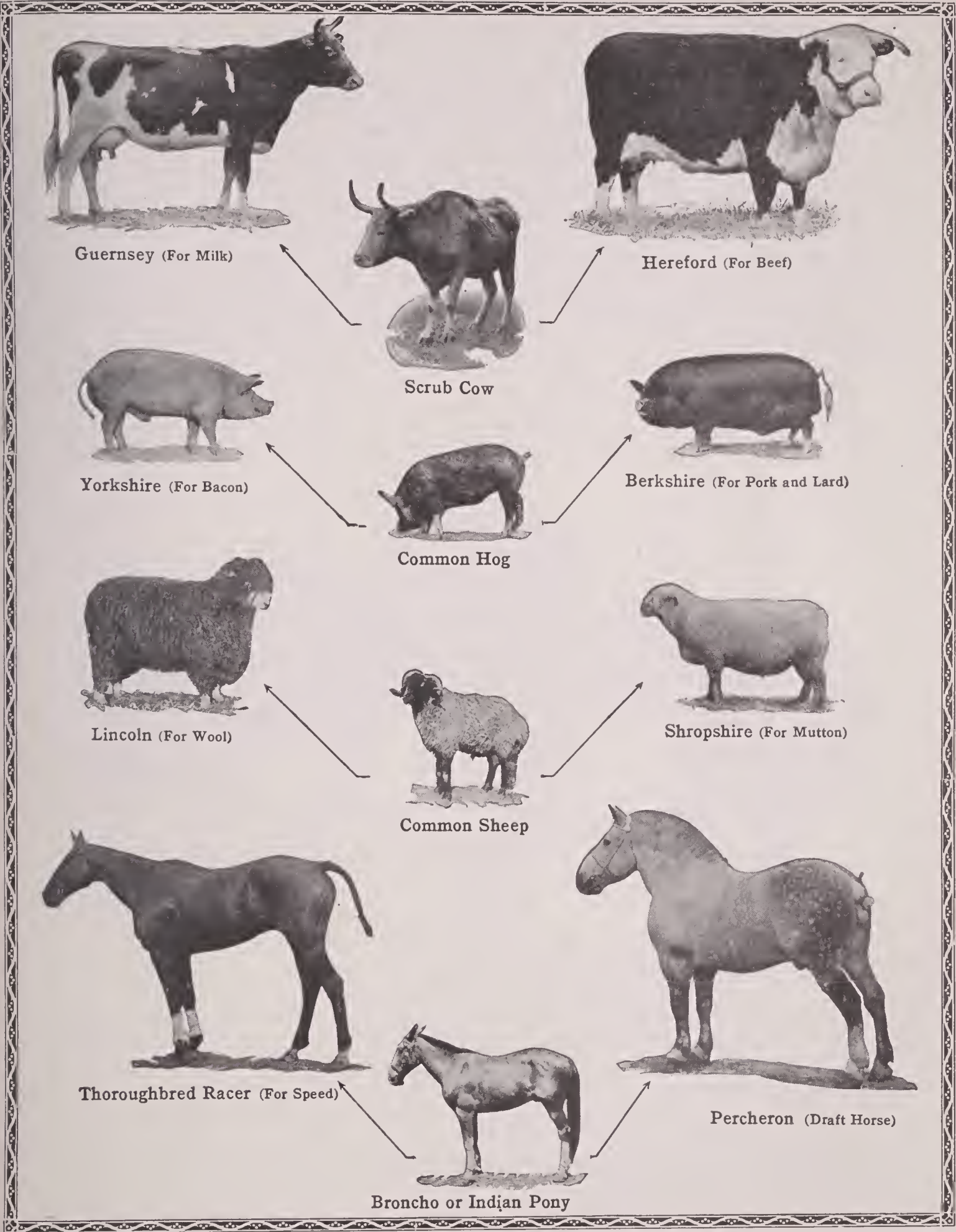
But after the breakup of the Roman Empire, there followed a thousand years of stagnation. All during the Middle Ages the most primitive practices prevailed. The upper classes devoted their energies to hunting and warfare, and left the tilling of the soil entirely to the ignorant peasants. During all this long period, agriculture was bound fast in the deadly grip of the open or unfenced three-field system. The land under cultivation about each village was usually divided into three great fields without hedges or fences. "Balks" of unplowed turf divided each of the fields into long and narrow strips of about an acre apiece, and each peasant cultivated from 10 to 30 of these strips. The curious thing is that no man's land lay all together. The holdings were so intermixed that each man would have several separate strips in each of the three great fields, thus losing much time in going from one to another.

A rude rotation of crops was practiced. All the holdings in one field would be planted one year with wheat or some other winter grain, the next year with spring grains such as oats or barley, and the third year they would be plowed and left to lie fallow. Thus one-third of all the land was always idle, to say nothing of the immense tracts not under cultivation at all. All incentive and opportunity for progress was thus removed, and the yield was so low that eight bushels of wheat to the acre was considered a good crop.

This condition lasted in England until the Black Death of the 14th century, which diminished the population by about one-half, led to scarcity of labor and caused a great advance in wages. To meet these conditions, many of the great landlords brought together and enclosed their domains and turned them into huge farms which could be more economically and scientifically cultivated, or pastured sheep upon them. The accumulation of capital presently made possible drainage fertilization, and other improvements which could only be carried out on a large scale. Thus the medieval system of small intermixed holdings gradually gave way to large enclosed farms.

Early in the 18th century came changes which practically amounted to a revolution in agriculture. The growing of root crops such as turnips was begun, and a root crop was introduced in the rotation plan in place of the fallow fields. This increased by practically one-third the production area in any year, and provided a surplus of feed for wintering stock. A four-crop rotation which has been followed more or less strictly to the present time is credited to Lord Townshend. Jethro Tull, another Englishman, invented the drill and introduced the method of sowing crops in rows so that they could be cultivated by a horse-hoe. Sometime after 1760 Robert Bakewell established the principles of breeding by which all breeds of farm live stock have since been improved by careful selection, mating, and feeding. Then followed the great revolution which accompanied the introduction of improved tools and agricultural machinery.

WONDERS OF SCIENTIFIC LIVE STOCK BREEDING



What a contrast between the common stock and the blooded stock which has been developed from it, as shown in this picture! Nothing could illustrate better the great and wonderful possibilities of bringing out desired characteristics in any desired direction. Contrast the common cow, for example, with the Guernsey, bred for milk, and then compare the Guernsey with the Hereford, bred for beef; the Yorkshire hog, bred for bacon, and the Berkshire for pork and lard; the Lincoln sheep, bred for wool, and the Shropshire, which is most valuable in the form of mutton chops; the clean-cut, fleet-footed thoroughbred running horse, and the heavy and powerful Percheron, formed for heavy work—both college-bred cousins, as it were, of the broncho. Without scientific breeding all live stock would be much like the common varieties shown down through the middle of the picture.

contained in the *Easy Reference Fact-Index* at the end of this work

The INVISIBLE OCEAN in Which WE LIVE

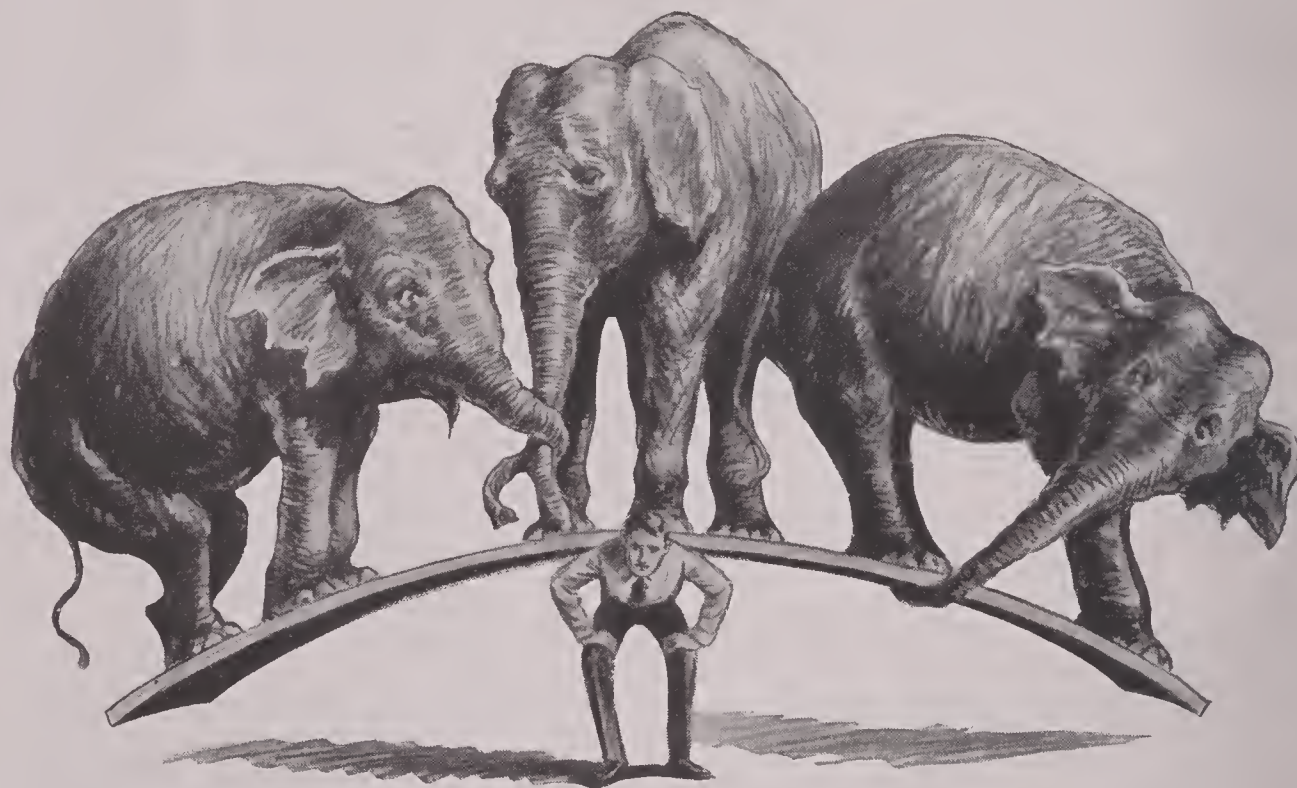
AIR. We live at the bottom of a gaseous ocean, the atmospheric air which covers the earth. Without air neither animals nor plants could live. Thus the moon has no life on its surface, because it has no atmosphere.

The climate which so affects the way in which we live—indeed often determines whether we can live—also depends upon the atmosphere and its movements. The cold winds from the north lower the temperature of a country, and the hot winds from the south raise the temperature. The winds also bring the clouds

***M**AN can live three weeks without food, three days without water, but only three minutes without air, says an old proverb. Though these figures may not be exactly accurate, they bring out in a striking way the prime importance of air to all life. Air is at once the commonest and the most valuable thing in the world. It takes part in every activity great or small on the surface of the globe, from whipping cream to hurricanes. It is a simple mixture of gases, yet has countless strange qualities little thought of but constantly used. Air makes man possible: here you may read how man has made air his servant. It turns our windmills, sustains our airships and airplanes, drives our ships, and is harnessed in a thousand ways for man's use.*

argon. There is about 21 per cent of oxygen, about 78 per cent of nitrogen, and nearly one per cent of argon. Argon is a very peculiar gas in that it makes no chemical combinations. Although it makes up one hundredth part of the atmosphere, it was first discovered as a separate gas in 1894 by Lord Rayleigh and Sir William

Ramsay. Besides these three gases, air contains minute traces of the rare gases neon, xenon and krypton, and a small fraction of a per cent of carbonic acid or carbon dioxide. Very "impure" air, such as



A HEAVY LOAD WE NEVER NOTICE

It would be rather hard for almost any of us to carry the weight of three elephants in the form shown in the picture. Yet, as a matter of fact, a medium-sized man has distributed over his body a pressure equal to thirty thousand pounds, or more than the weight of three good-sized elephants. Why we are able to sustain this enormous weight the article explains.

of water vapor over the land where it falls as rain, giving the moisture without which our food could not grow. The invention of the airplane and of the dirigible balloon has made possible flight through the air by men, so that some believe that the great highways for distance will in the near future be through the air. In fact, the air is essential to almost every activity, great or small, on the surface of the earth, and is certain to be even more important in the future.

And what is this marvelous substance, this air? Chemists tell us that it is mixture of a number of gases, principally of three gases, oxygen, nitrogen, and

is found in poorly ventilated rooms, contains larger amounts of carbon dioxide. Free air also always contains water vapor, and this varies greatly from place to place and from day to day.

Oxygen is the life-giving element of the air, the nitrogen serving merely to dilute the strength of the oxygen. If the atmosphere were pure oxygen, living organisms would "burn themselves out" too fast. The steel grate in the stove would catch fire, decaying leaves might even burst into flame, and many other startling outbreaks would take place.

The carbon dioxide in the air is produced by the

THE GREATEST HEIGHTS AND THE GREATEST DEPTHS

Ether of Space

Highly rarefied atmosphere
believed to consist of lighter gases
Hydrogen, Helium, etc.
Estimated depth from 100 to 150 miles

Upper limit of oxygen-nitrogen atmosphere estimated at 40 to 50 miles

Twilight Limit

+Point where
meteorite
takes fire

Highest measured altitude
Small balloon carrying
instruments only,
23.38 miles
at Pavia, Italy, 1912

Meteorite set on fire by air friction

Highest cloud limit
10 miles

Highest airplane
40,800 feet
Lieut. John A. MacReady
Dayton, Ohio,
1921

Highest passenger
balloon, 35,440 feet
Berlin, 1901

Highest kite, 23,712 feet
Highest mountain,
Mt. Everest, Himala-
yas, 29,002 feet

Deepest
point reach-
ed by submarine.
283 feet

Sea level air pres-
sure, 14.7 pounds
per square inch

Deepest point
reached by diver,
288 feet

Deepest point
in ocean, 32,088 feet
East of Mindanao Island, P.I.
Pressure 14,800 lbs. per square inch

Deepest hole
ever drilled by man
Lake oil well, W. Virginia
7,589 feet

Deepest mine,
Morro Velho, Brazil
6,126 feet deep
3,058 feet below sea
level

Here we have pictured for us many of the leading facts about the air. Since the highest measured altitude is only a little over 23 miles, you might wonder how we know the upper limit of oxygen-nitrogen atmosphere and the depth of the highly rarefied atmosphere above. One of the means of making these estimates is indicated in the part of the picture which shows the point where a meteorite is set on fire by air friction. From the point in the atmosphere where a meteor is seen to take fire, it is possible to estimate with a fair degree of accuracy the distance it must have traveled in order to have reached this degree of heat from the friction of the air, as indicated by the line which reaches from the little cross up to the region of the ether of space.

contained in the Easy Reference Fact-Index at the end of this work

action of the oxygen on the carbon, which is an important part of all organic or living matter. Every breath we draw forms carbon dioxide; every fire produces it. That is why the air in cities, where people are crowded together and where factory chimneys belch forth smoke, is less pure and healthful than country air.

How Plants Purify the Air

It may seem strange that this constant drain upon the atmosphere does not in the course of time make the air unfit to breath. This would actually happen if it were not for plant life. All green plants get their color from a substance called chlorophyll, which, under the influence of sunlight, seizes the carbon dioxide from the air, extracts the carbon for the use of the plant, and turns the oxygen back into the atmosphere.

While pure air may seem at first sight absolutely transparent, it is in reality not so. If it were so, the sky even in the daylight would look black, with the sharp bright spots of sun, moon, and stars scattered over it. But in fact, when the sunlight strikes the atmosphere of the earth, its rays are scattered by the tiny particles of air, and the blue rays are scattered farther than the red rays. Hence the light which comes to us from the clear sky is blue. At sunset the direct light from the sun is in general red because the blue rays have been largely scattered, leaving red the main color (*see Spectrum and Spectroscope*). The air also contains large quantities of fine dust particles as well as particles of water, particularly near the surface of the earth. These dust and water particles also scatter and separate the rays. The presence of dust particles in the air of a room can be seen when the room is darkened except where a narrow beam of sunlight comes in through a crack; the dust particles can be seen dancing in the path of the light. The dust particles in the higher atmosphere are in general much finer than those we see in a beam of light.

How much does air weigh? Much more than you think. It varies of course with the heat and the pressure; but at sea-level, and at the ordinary temperature of a summer day, one cubic foot of air weighs about .0729 of a pound. That means that $13\frac{3}{4}$ cubic feet—or the air in a cube-shaped box of which each side measures a little less than 2 feet 5 inches—weighs a pound.

How High Does the Atmosphere Extend?

It is estimated that for all practical purposes the atmosphere stops 40 to 50 miles from the earth. In a highly rarefied form it undoubtedly extends much farther than that before the pure ether begins, but we shall speak of it within this limit. When a balloon rises, it finds the air growing thinner and lighter, so that the difference between the weight of the balloon and the weight of the air it displaces becomes less and

less. When these two weights are equal, the balloon stops rising and floats at that level. If we decrease its weight by emptying sandbags overboard, it will rise to a higher level. If we decrease the amount of air it displaces by letting gas out of the gas-bag, it will fall to a lower level.

At very high levels the air becomes so thin that men

cannot live. The highest passenger balloon ascension on record is about seven miles; but balloons containing only scientific instruments have soared to much greater heights (*see Airplane; Balloon*).

Why You Can Carry That 30,000 Pounds

The weight of the air-belt around the earth produces at sea-level a pressure of 14.7 pounds per square inch. This means that upon the skin of a medium-sized man there is a constant total pressure of about 30,000 pounds. The reason he is not crushed is because air pressure is transmitted equally in every direction. He is like an inflated toy balloon with enormous pressure outside but an equally strong pressure inside, so there

is little strain on the delicate elastic tissue. When balloonists or aviators reach great heights, the outside pressure becomes so much less that blood often oozes from their ears, and they sometimes become unconscious from a rush of blood to the head.

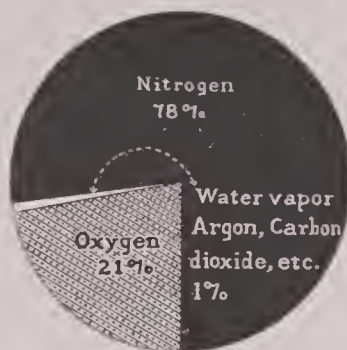
Since air varies in weight and density, it naturally varies in its resistance to objects passing through it. At tremendously high speeds this resistance is so great that the friction creates fierce heat. Shooting stars or meteors are cold until they strike the atmosphere of the earth, but the heat of friction then becomes so intense that the rock or mineral of which meteors are composed catches fire and they usually burn up before they reach the ground. The height at which they start to burn is sometimes used to estimate the thickness of the earth's air belt.

Air Resistance and Air Pressure

But if the air resistance hinders our progress in one way, it is invaluable to us in another. Without it, an airplane could not rise from the ground, for it is by driving the inclined planes against the dense atmosphere that the motor is able to force the weight of the machine upward. In a vacuum a feather and a ball of lead fall with equal speed.

Another important fact about air is that it is compressible and is elastic; that is, when compressed it exerts an expansive force opposing the compression. Thus by means of a compression pump we blow up the tires of our bicycles and automobiles, and the compressed air is even more elastic than rubber. By storing compressed air in tanks, the expansive force of the air can be used later for power, as in air brakes on railroad trains and street cars, in rock drills and riveters, and in many other devices worked with compressed air (*see Brakes*).

THE INSIDE FACTS
ABOUT THE AIR WE
BREATHE



This illustration shows graphically what air is made of. A little over three-fourths of it is nitrogen, something less than one-fourth oxygen and the remaining 1% water vapor, argon, carbon dioxide, etc.

In that dangerous toy, the air-gun, the bullets are discharged by means of compressed air instead of gunpowder. A lever attached to a piston forces the air into a chamber, usually in the stock. This chamber has a valve opening into the barrel just behind the place where the bullet is lodged. When the trigger is pressed, the valve is opened and the compressed air rushes into the barrel, forcing the bullet out.

The pressure of the atmosphere is what makes suction possible. A suction pump does not *draw* the water upward. It simply exhausts the air pressure in the pipe above the water, and the pressure of the air on the water outside the pipe forces it up inside.

Some Interesting Things to Do with Air

Place a lighted candle beneath the bowl and then exhaust the air. The candle will go out for lack of oxygen. Insects and animals will die under the same treatment. If an electric bell is set off inside the bowl after the air is exhausted, it can scarcely be heard, for there is little or no air to carry the vibration of sound. Put a glass of water which has just stopped boiling under the bowl; when the air is pumped out, the water will start to boil again, for the temperature at which liquids will boil becomes lower as the air pressure decreases. A toy balloon which contains air will swell up and may burst when the air around it is exhausted.



It's the Air that Does It

Many simple experiments can be made without the vacuum pump. Take a glass, fill it with water, and then lay a smooth sheet of paper over the top. Now turn the glass upside down, holding the paper closely over the mouth of the glass with one hand; then take the hand away. The paper will hold the water in without any other support, showing the power of air pressure.

The Bottle and the Egg

Drop a piece of lighted paper into a large milk bottle. Take a moderately hard-boiled egg, from which all the shell has been removed, and put it point down in the mouth of the bottle after the paper has burned up. In a few seconds the egg will start to move down into the neck. If the egg is not too large and hard, it will presently pop into the bottle with a loud noise. This is because the burning paper heated the air, which expanded, so that some of it was driven out through the neck. After the egg was placed in the mouth the air cooled again and contracted, causing a partial vacuum so that the pressure of the outside air forced the egg downward.



Making a Bottle Suck an Egg

You can easily show that the air has weight by weighing a deflated football bladder on a delicate pair of scales, then pumping it full of air with a bicycle pump and weighing it again.

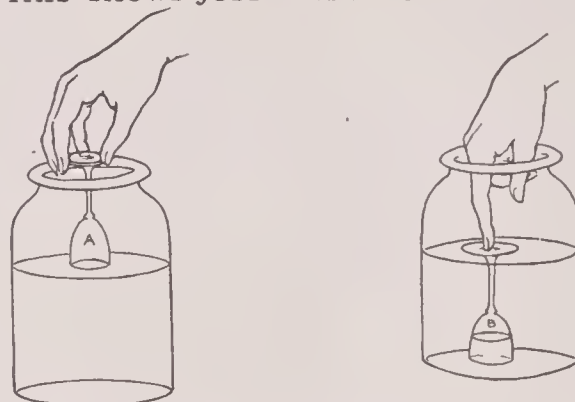
The bladder when filled with air is heavier than when empty, though it may seem lighter because of its buoyancy, and the difference is exactly the weight of the compressed air that you have pumped into it. With larger objects, such as automobile tires, the weight of the air is great enough to be easily observed by merely your muscular

Since the pressure of the air is limited to 14.7 pounds per square inch, there is of course a limit to the weight of water it will force up into a pipe. This limit is reached at a height of 32 feet. It is impossible to make water rise higher than that by suction. Liquid mercury is $13\frac{1}{2}$ times as heavy as water, therefore atmospheric pressure will support a column of mercury only about 30 inches high. This is the basis on which the mercury barometer is made (see Barometer).

Most of the qualities of air can best be illustrated with the vacuum air pump. In its simplest form it is a pump so arranged that it will suck the air from beneath a large inverted glass bowl or "receiver."

sensations. Next time you get a puncture and have to change a tire, lift the punctured tire and then the inflated tire you are about to put on; you can easily feel the difference, which is due solely to the weight of the air.

THIS SHOWS JUST WHY A POPGUN POPS



This experiment, as explained in the text, shows why your popgun pops. The air in the gun is compressed and allowed to expand suddenly.

Still another experiment will show that air, like all gases, is elastic and can be compressed. Take a small tumbler or wine-glass with a stem and invert it on the surface of a jar or basin of water. The glass when it touches the water is full of air, as is shown in Figure A. But if you press the glass down to the bottom of the jar, you will see that some water rises in the glass, so that the air only partly fills it (Fig. B). The explanation is that the pressure of the atmosphere on the surface of the water has forced the water up into the glass, compressing into a smaller space the air that formerly filled it.

Showing Expansion by Heat

To show that air expands when heated, take a slender glass tube closed at one end. Put the open end in a bowl of water. The water will rise in it to a certain level, compressing the air as in the previous experiment. Now hold a flame to the upper part of the tube, and presently the level of the water in the tube will be lowered, as the heated air expands and forces the water out.

When air is compressed and at the same time reduced to a temperature of about 312° below zero Fahrenheit, it becomes liquid, and has many interesting properties (see Liquid Air).

In recent years much study has been made of methods of "fixing" atmospheric nitrogen for commercial use. Nitrogen does not unite chemically with other substances, that is it is not "fixed," except with great difficulty and under special conditions; and yet these compounds are necessary for agricultural fertilizers and for explosives. To make these nitrates, the United States government spent many millions of dollars during the World War in experimental and operating plants (see Nitrogen).

The SOARING MOTOR-CAR of the AIR



ONE OF THE EARLY
"BIRDMEN"

This isn't Darius Green and his flying machine. It is the artist's way of typifying the various fantastic attempts men made at flying before they settled down to the careful scientific study of the problem and so, step by step, finally solved it with the simple but no less wonderful airplane of today.

the driver let it go. But you have seen a thing that clever men and wise men hardly dreamed of years ago; you have seen a thing that wise men scoffed at even when you were born—you have seen an airplane riding through the clouds!

In all the history of the world there has hardly been anything equal to that. Think of it in any way you like, and it must seem to you a miracle. Throw a stone up into the air and it falls down; throw a stream of water up and it comes back to earth; throw a feather up and, although it floats a little while on the wind, it soon glides back to the solid earth.

They fall, all of them, by what we call the law of gravitation, which means that the earth pulls everything towards its center. A pebble rolls down hill; water runs to the lowest point. It is the pull of something in the mass of the earth that draws all things towards it as a magnet draws a needle. It will pull a flint out of a chalk bank if we give it time; it will pull down an overhanging tree if it is left long enough without support. This universal power of matter to attract other matter to it, the larger mass attracting a smaller, is one of the mysteries that no man understands.

And yet an airplane flies past a mile above our heads, so high that it looks like a bird, so beautiful that it looks as if Nature herself had made it, so confident of its power as it passes out of sight that it thrills a man to feel that he belongs to the race that made it. Now it is a speck! Soon our eyes will lose it, but we know that there is a man up there.

FOR ages men looked up hopelessly into the blue sky, envying the birds. Then came balloons that floated amid the clouds. But men were not satisfied: "We want to fly as the birds fly," they said. One of these "mad dreamers" was an American scientist, who after years of work in his laboratory said, "It can be done!" The world scoffed at him. But the Wright brothers believed and said, "It shall be done!" and they succeeded. As a result, men today fly faster and higher than any bird, carry huge weights on thin swift wings far above the clouds, and leap over the oceans.

AIRPLANE. Never did things change so fast as in these days. Your grandfather's father may have seen the coming of the steamboat, struggling along the river or lying with its nose against the banks. Your grandfather saw the early railway train, which came pushing proudly into the world at 20 miles an hour. Your father saw the motor-car riding the roads like a giant of power at a mile a minute when

It is not the first contrivance that has taken a man up in the clouds. There have been balloons and there are airships, but the "flying motor-car" which we call an airplane is far more wonderful than these. The balloon and the airship are lighter than air, and they sail in the sea of air in which we live as easily as a ship sails on the sea of water in which the fishes live. But the airplane is heavier than air.

Why an Airplane Flies

Remember that air is something very real. It is so thin that we cannot see it, so fine and colorless that we can hardly believe it is there. But it is as real as the chair you sit in, and it has weight as water has, strength as water has, power to bear things on it as water has. When you fly a kite it is sailing on air; it rests on the air beneath it.

A thing that is lighter than the bed it lies on cannot sink into its bed. Put a feather on a feather bed and the bed will remain undisturbed, but put a piece of iron there and the bed will give way to it. It is so with water. A feather is lighter than water, and will float; a piece of iron is heavier than water, and will sink. But if you take a basin and rest that on the water, the basin will float because it has much more water to rest on and is not so heavy as its bed.

And so, if you beat a mighty sheet of iron into an enormous basin, it will still float, because, as long as it is filled with air and rests on an enormous stretch of water, it is lighter than that great body of water. Even if you put heavy engines in this iron basin, and fill it with people and thousands of tons of all sorts of things, it will float like paper on the sea, so smoothly that sometimes it will go a thousand miles and a glass of water would not slip off a table with the rocking.

So an iron ship sails, though it weighs a thousand tons. So an airship sails with its heavy engines, with its crew of perhaps 20 or 30 men, all held up by an enormous bag of gas, which, even with the load that hangs on it, is lighter than the bed of air it rests on. The airship and the water-ship have gravitation on their side—that is to say, they rest on something heavier than themselves, and gravitation does not pull them down; they sink naturally into their bed. But the airplane has gravitation against it, and it must fight all the time for its life.

How does it do it? How does the great weight keep up there, heavier than the air it rests on?

There are many ways in which we could explain it, most of them difficult to understand unless we go

into the laws of physics and into mathematics; but one of them is simple.

An airplane flies for much the same reason that a kite flies. The wind strikes under the inclined surface of a kite, and as long as the string keeps it from being blown backward, the wind force holds the kite up. Even on a perfectly calm day a kite will fly if you "create" a wind by running with the kite string.

An airplane's wings are inclined like the surface of a kite. The engine and whirling propeller take the place of the kite string and the runner. The airplane "creates" its own wind. It is the power of the engine alone that keeps it going. The engine turns the propeller and the propeller draws the flying chariot behind it. Take a screw and let its point get a grip on a piece of wood, and it will draw its whole length into the wood with powerful force. Put a big screw on a ship and drive it into the water, and it will carry through the water the ship and all that is in it. Put a screw into an airplane and drive it into the air, and it will carry through the air whatever is fixed behind it.

Screwing a Path through the Air

The propeller is the screw. It screws its way through air, which is as real as wood and water. The air resists the propeller of an airplane, but the propeller screws its way exactly like the screw of a ship or the screw in a piece of wood, and the airplane must follow where the propeller goes, and as it rushes through the air, the inclined planes are not only

THE "FOLLY" AS IT FLEW



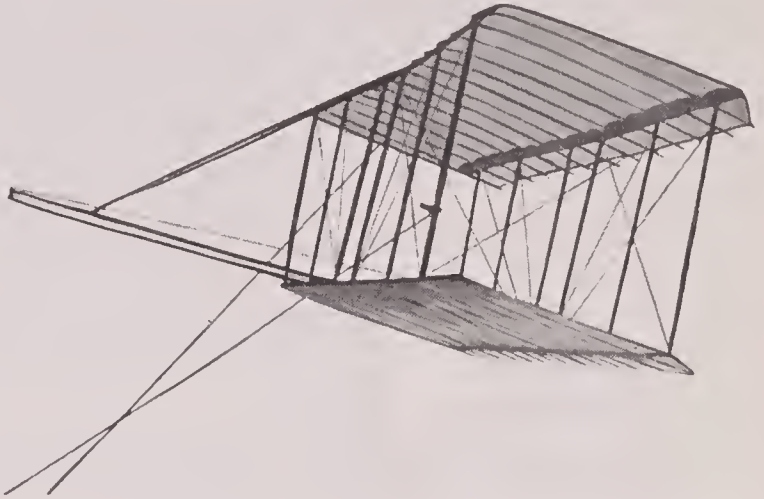
Although Professor Langley did not reach the point of building a flying machine that would carry a passenger, he did build a machine—a model of only $1\frac{1}{4}$ horse-power—which was the first heavier-than-air machine driven by its own power to make a successful flight. The Wrights, who made flying machines practical, used the information obtained by Professor Langley in his experiments. Up to this time it was the fashion among the newspapers to regard the idea of flying as an impracticable dream, and this model was known as "Langley's Folly."

pushed upward by the air beneath, but the wings are so shaped that their great forward speed creates a vacuum on their upper surface which holds them up by suction, so to speak. This upper vacuum is one of the most important features of flying.

Remember that air is matter, and the thought of an airship riding on it, or an airplane screwing its way through it, will be easier for you to understand. The flying motor-car cannot stand still like the floating airship, but as long as its engines drive this propeller around, it will screw its way through, and

the marvelous things that control its wings will send it up into the clouds or bring it slowly back to earth. The way is not always smooth. It is bumpy at places; there are hills and dales for the airplane to cross; and suddenly it may fall a hundred feet. But

THE GREAT-GRANDFATHER OF ALL FLYING MACHINES



This affair, simpler even than your box kite, may be said to be the great-grandfather of all flying machines. It is the kite first used by the Wright brothers in making experiments with heavier-than-air craft. Next came the glider without power—the grandfather. Then the introduction of the engine that supplied the power—the father of all types of flying machines.

it will right itself with perfect ease; and the control of man over his new motor-car of the skies has become one of the greatest human triumphs of all time.

Today, in regions with regular mail, express, and passenger air service, the whirr of an airplane winging through the sky scarcely wins a glance from the man in the street or the farmer at his plow. Flying machines speed from one side of the continent to the other; they hop across oceans; they carry tourists, men in the rush of business, public officials hurrying to distant conferences, physicians on emergency calls. In fact, the airplane has taken its permanent place with the locomotive, steamship, and automobile.

The prospect of flying has fascinated men since the ancient days of fabled Icarus, who flew so near the sun that the wax fastenings of his wings melted, dropping him to his death in the sea. When scientists had learned something of the properties and resistance of air, there appeared from time to time men who said: "If the eagle, which is heavier than air, can fly, why can't man fly if we invent the proper wings?" They were answered with elaborate figures to show that the proposals were ridiculous, and that only with the balloon, which is lighter than air, could man ever hope to navigate the heavens.

To the United States Belongs This Discovery

To the United States belongs the honor of having proved in theory as well as in practice that it was possible for men to fly in heavier-than-air machines. Haphazard attempts without scientific basis had been made in Europe. Then it was demonstrated by means of huge box kites and "gliders" launched from hilltops that the human body can be sustained in

the air with properly balanced planes, provided sufficient air pressure is brought to bear on the under surface of the planes, either through the force of the wind or the momentum imparted to the machine. It remained, however, for Prof. Samuel Pierpont Langley, secretary of the Smithsonian Institution at Washington, to demonstrate the laws of self-propelled mechanical flight.

Professor Langley constructed a 16-foot model, which he called an "aerodrome," and equipped it with a small steam engine. On May 6, 1896, this machine, which resembled in form the modern airplane, flew unattended over the Potomac River for a minute and a half, the full time of its water and fuel supply. It

"BELLY-BUSTER" IN THE AIR



After the Wright brothers had worked out certain principles with their first box kite, they made another kite called a "glider," on which you here see Wilbur Wright sailing through the air. It had no engine. He just ran with it, as you run with a sled, and then jumped off a high place and was carried forward some distance. In this way the problem of the wings was solved. The next thing was to supply motive power.

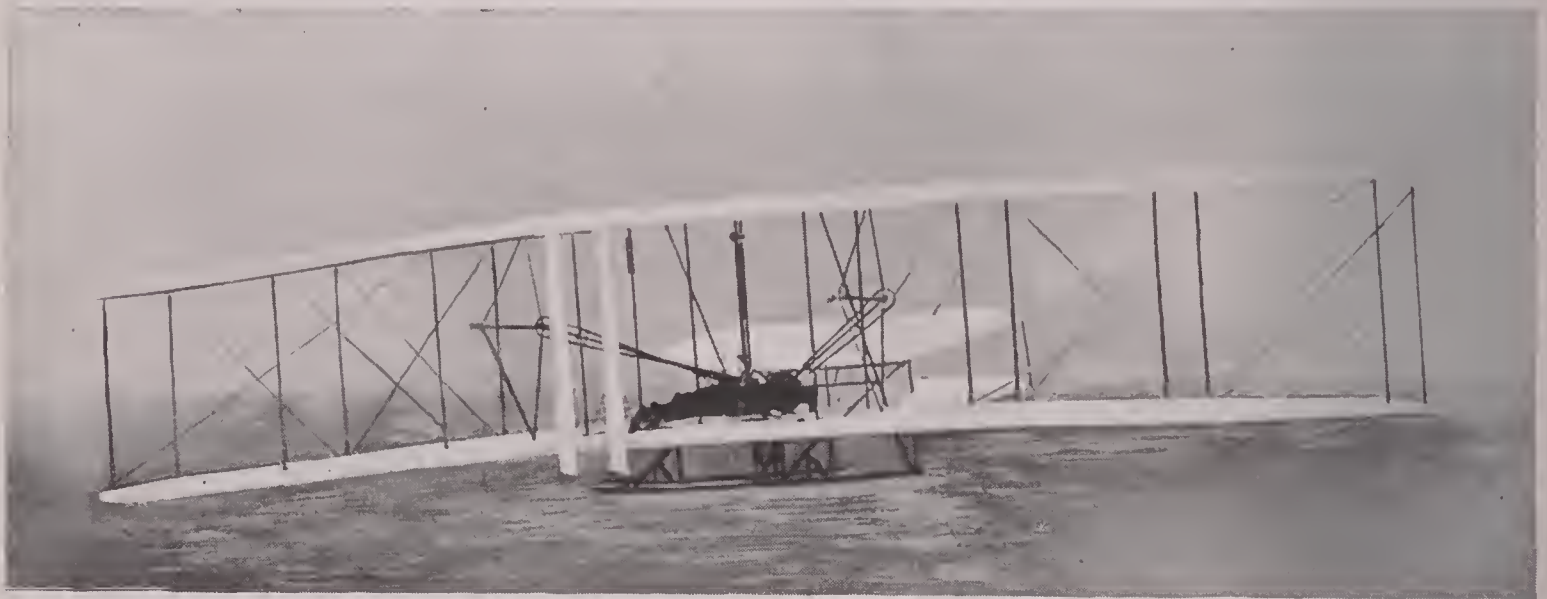
the machine dove into the river and was wrecked. Ridicule and lack of financial support then caused Professor Langley to abandon his project.

Nine days later, on December 17, while the newspapers were still jibing at "Langley's folly," an epoch-making event took place in the sandy hills near Kitty Hawk, N. C. A machine driven by a six-bladed propeller

attached to a gasoline motor rose from the ground, carrying a pilot, and flew 852 feet in 59 seconds. The pilot was Wilbur Wright, who has gone down to history as the first real "birdman." His brother Orville, who had helped to build the machine, watched the experiment from the ground.

Encouraged by Professor Langley's advice and

AND NOW THE FLYING MACHINE FLIES

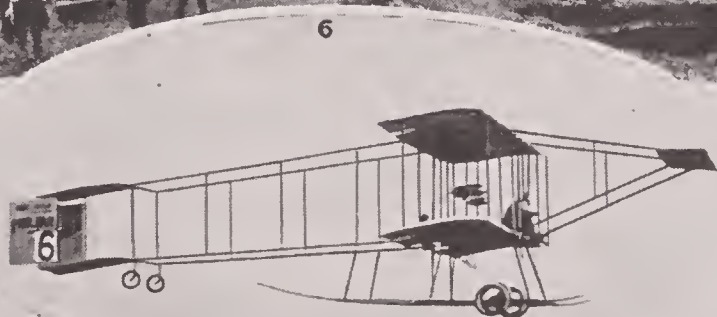


Here you see the great problem of the flying machine solved, so far as actual flying is concerned. It shows the first successful airplane at Kitty Hawk rising from the ground—"taking off," as the airmen call it. It stayed in the air only a few seconds when it suddenly darted for the ground the way your kite often does, but it was the first time in the history of the world in which a machine carrying a man had raised itself by its own power into the air in full flight. At last the myth dream of the Greeks in the story of Daedalus had come true!

covered more than half a mile, then settled gently to the surface of the river. Seven years later Professor Langley completed a man-carrying machine. On Dec. 8, 1903, piloted by the inventor's assistant, it was launched from the roof of a houseboat on the Potomac. Crowds had gathered to see the experiment. But something went wrong with the launching gear, and

example, the Wright brothers had been experimenting for several years at their home in Dayton, Ohio. They had seen that in the gasoline engine, which was still somewhat of a novelty, lay the future of flying. Unable to find a light enough engine on the market, they built their own, which developed 8 horse-power. The entire weight of their biplane, including the

FLYING MACHINE HISTORY IN PICTURES



No. 1 is a passenger-carrying Bleriot monoplane of the same type as that used by Louis Bleriot in the first flight across the English channel, from Baraques to Dover, on July 25, 1909. Bleriot was the first to build a successful monoplane.

No. 2 shows the earliest type of hydroplane. Glenn Curtiss, the inventor, is standing on the pontoon, having just alighted on the water after a successful flight.

No. 3 shows Atwood arriving at Grant Park, Chicago, after a flight from Washington, D. C. This was one of the earliest long-distance air journeys.

No. 4 shows the first machine to make a flight in public. It was

pilot, was 800 pounds. For the next five years they were busily occupied in perfecting their apparatus.

In the United States the achievement of the Wright brothers made a great sensation, but both the government and the public failed to see its usefulness. The young inventors received little financial encouragement at home. When they went to Europe, France seized eagerly upon the new invention. French engineers set at work to improve the details of the biplane, and devised new models which included the monoplane. As a result of their work, supremacy in the

built in 1906 by Alberto Santos-Dumont, who was already famous for his work with dirigible balloons. This curious airplane with its box-kite wings gave its first exhibition near Paris on August 22, 1906, but

this type of flyer lacked strength of construction for long flights.

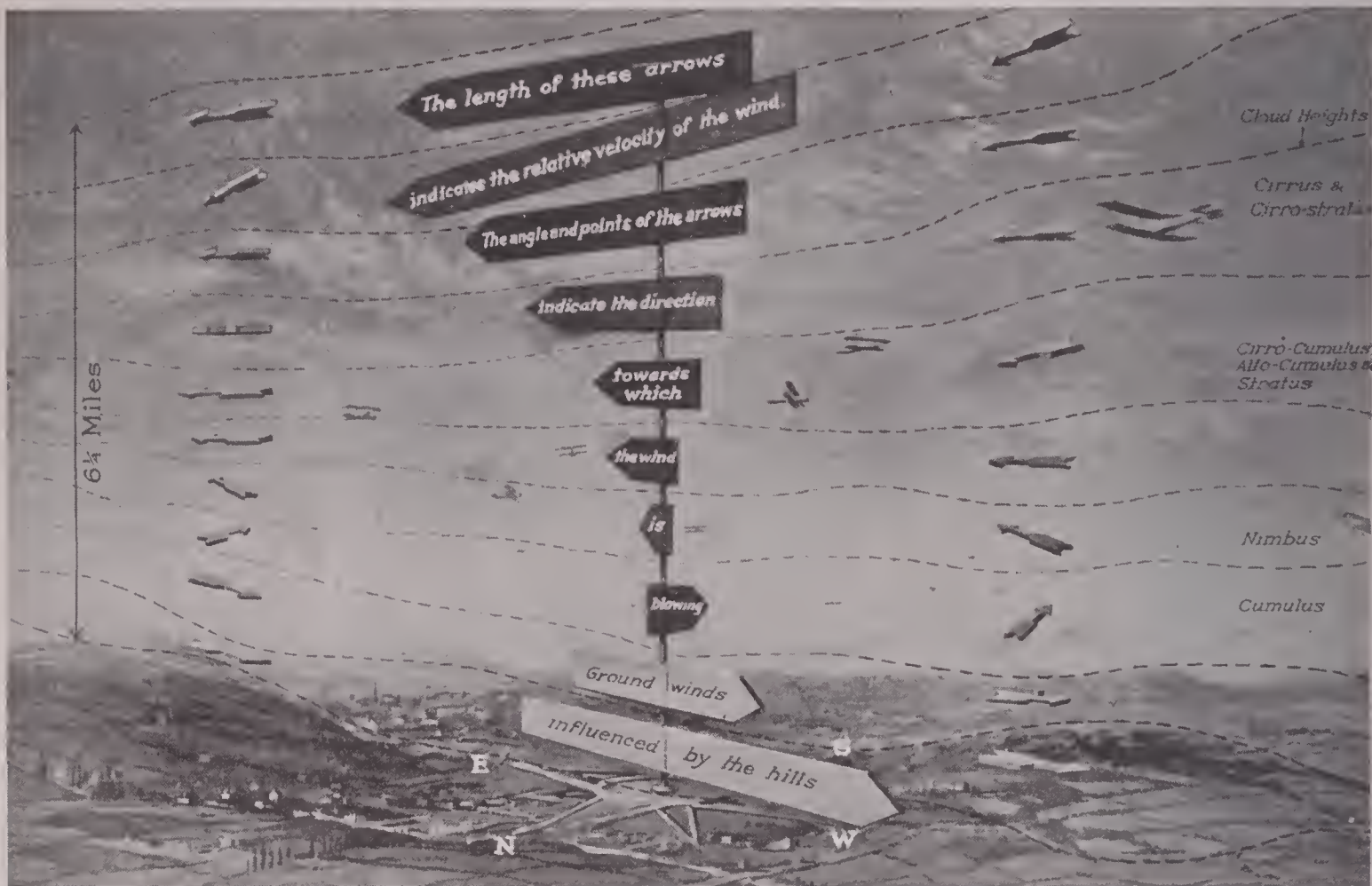
No. 5 shows one of the earlier types of Wright biplanes. Orville Wright is seen standing in front between the bars of the framework, and Wilbur Wright (the man with the black hat) is helping to hold the tail of the machine, while the engine is being tested.

No. 6 shows Paulhan, one of the pioneers of aviation, flying in one of the famous Farman biplanes. It illustrates the attempt, afterwards abandoned, to steady the craft by that projecting fin in front.

air soon passed to the French, who held virtually all the flying records from 1908 to 1914.

There was a reason behind this. In those days few people imagined that the airplane would ever be commercially useful. It seemed too unstable a vehicle. But the shrewdest military authorities foresaw at least a part of its value as a war machine. The United States did not look at the world through military eyes, and let the opportunity slip. It was not so with the nations of Europe, who were sleeping on their arms expecting the great conflict.

WHY IT IS BEST TO FLY HIGH

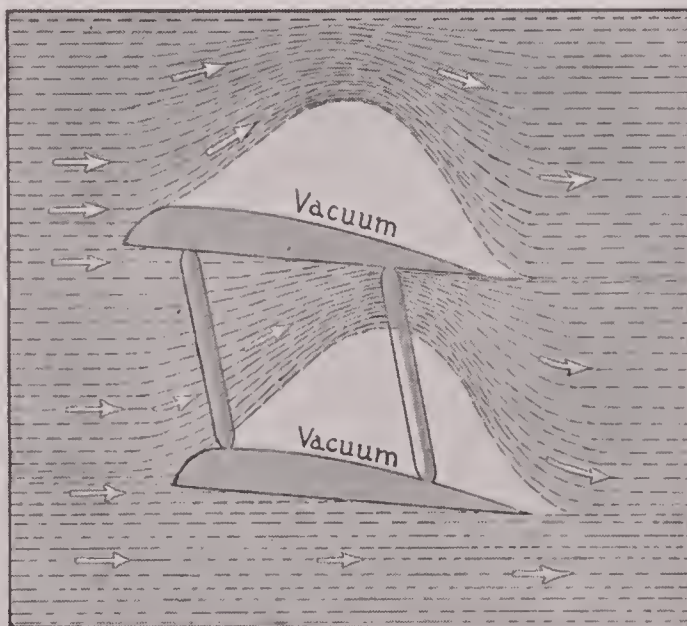


The safest height for flying is 3,000 feet and above. This picture shows the reason. Below this height the wind—particularly where the earth's surface is uneven—blows at various angles and velocities, so that there are formed what are called "pockets," into which your machine may suddenly pitch and so cause you to lose control of it.

In the hundreds of experiments which followed, the chief difficulty was the evolution of a new type of motor which should combine great power with little weight. The invention of the Gnome rotary engine, in which the cylinders arranged like the spokes of a wheel revolved, while the crank shaft remained stationary, was the first great step in this direction. In this engine the propeller was fastened directly to the revolving crank-case, and the engine cooled itself by the very speed of its whirling. Later the form of engine with stationary cylinders of the automobile type was improved, until it excelled even the Gnome engine.

The form of the airplane itself was soon reduced to a few standard types—monoplanes, biplanes, and triplanes; "tractors" and "pushers." The tractor type has the propeller in

THE VACUUM THAT AIDS THE PLANE



Here we see how the air, when it is struck by the "hump" on the upper forward edge of an airplane's wings, is thrown upward in a curve, creating a vacuum above each wing. It is this vacuum which gives the wing most of its lift. Indeed, we may say that an airplane is literally pulled up into the air by the suction which its own speed creates. To prevent the upper wing of a biplane from interfering with the vacuum of the lower wing, it is built farther forward, as you see here.

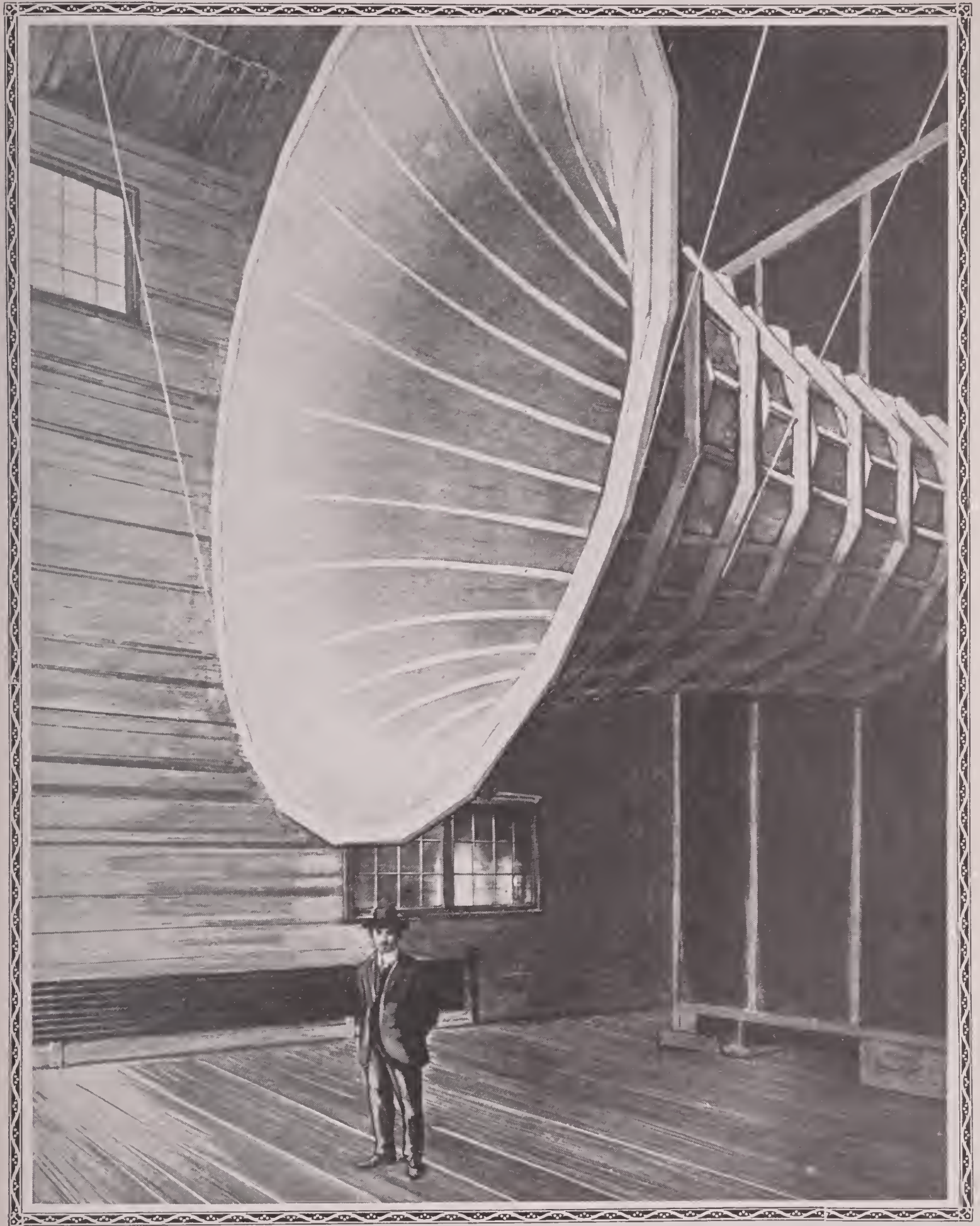
front, pulling the machine through the air; the pusher has it at the rear of the planes. The monoplane, offering to the air the resistance of only one set of wings, is the speedier machine; but the biplane, with its greater wing surface distributed over two levels, proves steadier and more reliable. The triplane is particularly useful for raising and carrying heavy loads.

The Airplane in the World War

Independent experimenting might have continued for years, with slow improvement, had it not been for the World War of 1914-18. Suddenly this fierce test was put upon the airplane, which was then only nine years old.

The next four years saw the most remarkable development ever achieved in any human invention. France entered the war with 500 to 600 fairly service-

HOW LITTLE FLYING MACHINES ARE TAUGHT TO FLY



From a toy sewing machine making a doll's dress, you could see exactly how a big sewing machine of the same type would work; that's plain enough, isn't it? But how in the world could a toy flying machine with wings not much bigger than a pigeon's—and standing still, mind you—show how a big machine with a wing span of 100 feet would act when traveling at the rate of 100 miles an hour? This is how: Suspended by wires a little way inside this enormous tube with the bell-shaped mouth—that mouth is more than ten feet across—is a little model of a flying machine, and at the other end of this tunnel is an engine with a suction fan attached to it that draws wind through the tunnel at the rate of 60 to 100 miles an hour. Although the little flying machine is not flying at all, it behaves in this draft of wind as if it were sailing forward at whatever rate the blast is blowing. In this way the flying machine builders find just what changes need to be made in order to make the big plane built on the model a success, and they keep tinkering with it until they get it to do what they want it to do.

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able machines; their chief defect was their great variety, a fact which made it difficult to provide standard parts to keep them in repair. Great Britain, where no great official encouragement had been given to airplane builders, had only 82 machines. Belgium had perhaps an equal number. Germany, on the other hand, had standardized her military planes under government supervision, and had between 600 and 700 machines.

No nation, however, had dreamed of actual air battles. The war planes were designed for observation or sentry purposes only, with perhaps some expectation of use for bomb-dropping. But it soon became obvious to the army leaders that, besides observing the troop movements of the enemy, it was an important part of the "game" to prevent the enemy from observing their own activities. French flyers, therefore, began to carry pistols and rifles into the clouds to shoot down German machines. The Germans replied in kind, and it was not long before airplanes on both sides were equipped with machine guns, and the "war in the air" began in earnest.

Even greater changes were going on behind the lines. The countries at war saw that the "general utility" airplane was not efficient. Under the pressure of the tremendous life-and-death competition, they began specializing in different types for different purposes. Small single-seaters, capable of great speed and rapid climbing, were designed for actual air battles. These had machine guns mounted in front and accurately timed to fire between the whirring blades of the propeller. For scouting or observation purposes over the enemy's lines and for directing artillery fire, heavier biplanes were built, capable of carrying, in addition to the pilot, an observer with his maps and instruments; those were equipped with two machine guns, one of which could be turned to fire in any direction. Finally for long distance bombing raids very large and powerful biplanes and triplanes were constructed, which could lift a great weight of explosives and a large supply of gasoline. Toward the end of the war some of the bigger "bombers" were equipped with steel armor, to protect them against machine-gun fire.

The progress in land flying was followed by equal progress in sea flying. Before the war many experiments had been made with airplanes mounted on boat-shaped skids called pontoons, which made it possible to start or end a flight on smooth water. The seaplanes developed by the opposing navies during the war soon surpassed everything that went before. They were made to ride rough seas for hours, if necessary, and to stay in the air from sunrise to sunset. The British, and later the American, seaplanes proved immensely valuable in detecting German submarines, which they could pick out by reason of the height at which they flew, even when the diving boats were far under water. In several instances they even dropped bombs directly upon the "U-boats."

Both army and navy planes came to be equipped

with wireless telegraph or wireless telephone apparatus. Instruments for registering altitude, speed, and angle of flight, special compasses, drift-meters, and a number of other attachments peculiar to air travel were speedily invented and put into use.

In addition to their actual fighting duties, airplanes proved of great value for rapid passenger service. Military commanders were able to fly to the front lines, take note of the whole panorama of battle, and return to headquarters, all within a few minutes. Frequently high officials of the allied nations flew back and forth across the British Channel to attend important conferences.

It has been often said that the airplane revolutionized warfare, but it is no less true that warfare revolutionized the airplane. Inside of four years, airplane building, which had been an expensive hobby, became an established world-wide industry. Backed by the enormous resources of great nations, engineers of the highest skill attacked the problem of flying, and soon overcame its chief obstacles.

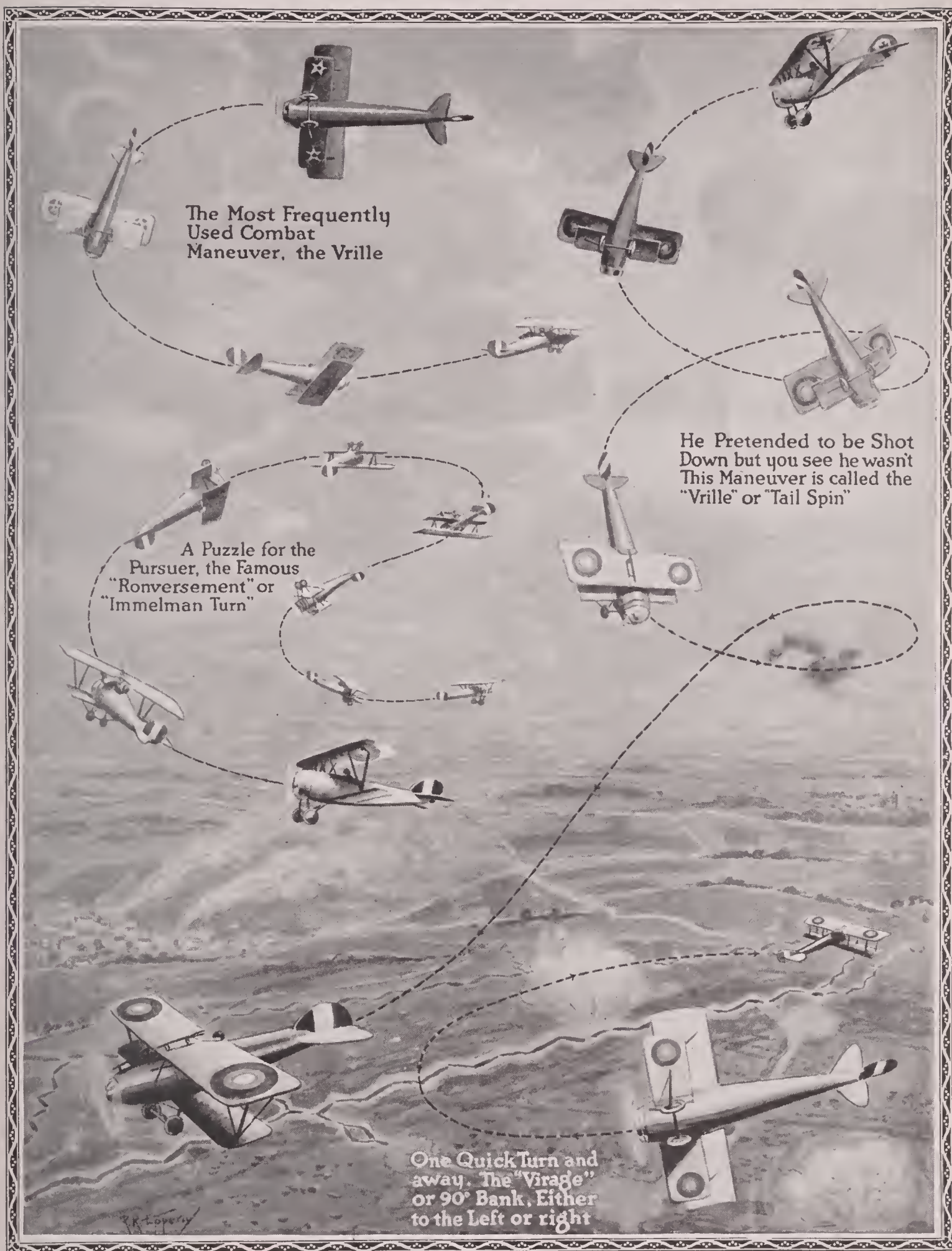
Perhaps the greatest advance was made in the development of the gasoline engine. At the beginning of the war the ordinary airplane motor weighed 437 pounds and developed 112 horsepower, thus weighing almost four pounds for each horsepower. By the close of the war, the United States, in its famous Liberty motor, had developed an engine which weighed only 1.8 pounds per horsepower and which could be turned out in large numbers through "quantity production" as a result of standardized parts. It was not, however, applicable to the smaller fighting machines.

The Airplane in Time of Peace

No sooner had the fighting stopped in western Europe than the nations sought to apply their airplane experience to peacetime pursuits. Regular mail service was established between the principal cities of the United States, and Europe soon followed this lead. Air express and air passenger traffic came next. Private companies built huge machines with glass-enclosed cabins, containing tables, chairs, writing desks, heating apparatus, electric lights, and carrying 25 or more persons in great comfort. A regular service between London and Paris was soon established. Early in 1919 an Italian machine carried 78 passengers aloft, and an American flying boat took up 51. The best war speeds were soon equalled and surpassed. A biplane flew from Washington to New York in 80 minutes, at a rate of 162 miles an hour, and a few days later this sustained speed was raised in a Middle-West flight to 167 miles an hour. At this velocity Chicago is brought within five hours of New York and San Francisco less than 20. Even greater speeds have since been reached. Short flights have been made at the rate of more than 190 miles an hour.

Daring flyers have also attained tremendous heights. One of the most spectacular attempts to set new altitude records was that of Major R. W.

TRICKS THE FIGHTING AIRMEN PLAY



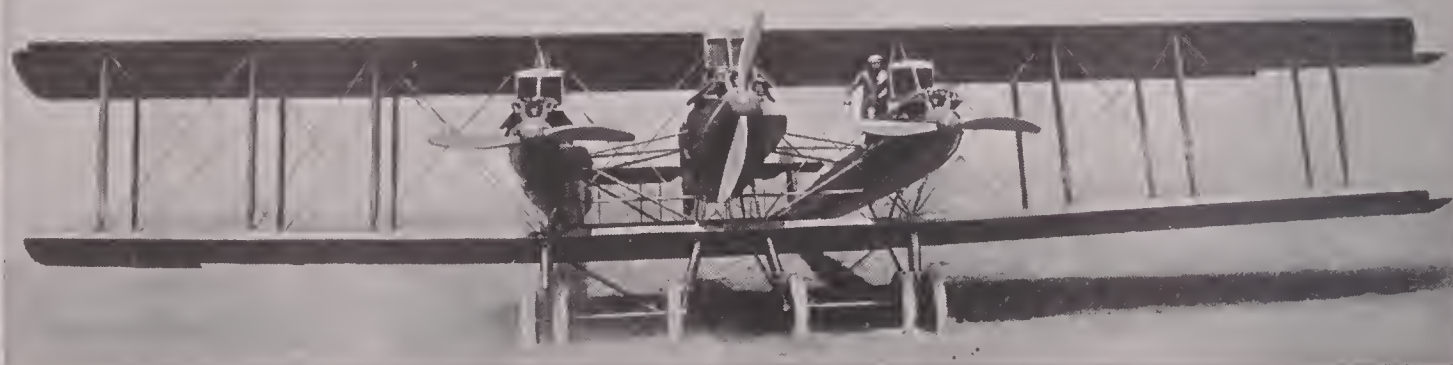
At the top on the left you see one of the commonest and most useful of combat maneuvers, the "vrilie," or "tail spin." The pilot banks his machine sharply and dives, immediately straightening out. To the right you see the same maneuver repeated in a series of loops, which mimic the action of a machine which has got out of control. In the center to the left the famous "Immelmann turn" is represented. In this the flyer climbs sharply as if about to "loop the loop," but instead, at the height of the loop, he suddenly twists the machine about and straightens out at the higher level. In the lower right-hand corner is shown the quickest way to turn an airplane—the "virage," or sudden bank in which the wings are perpendicular to the earth.

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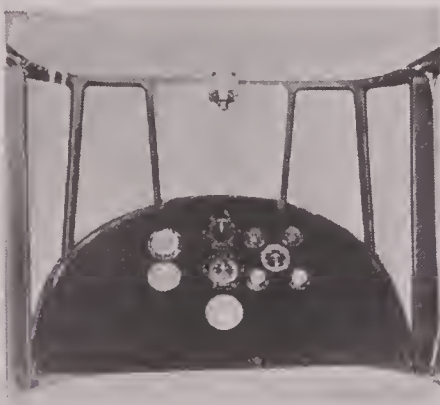
SOME INTERESTING MECHANICAL BIRDS



The picture at the left shows the De Havilland battleplane, one of the most successful American types. Attached to the front of the radiator are the roaring blades. In some of the battleplanes the gun fires its bullets directly between these whirling blades, the firing of the gun being so timed by delicate mechanism that it goes off just after the blade has passed a given point. To the right is one kind of flying machine that carries United States mail. It is built of metal throughout, while in most flying machines much wood is used. It has the advantage of being fireproof.



This is one of the giants of the airplane family. It is 106 feet wide from wing tip to wing tip, has two fuselages, or bodies, each 50 feet long, and a large car in the center which will hold a crew of four men. It can remain in the air 16 hours and travel at the rate of 110 miles an hour with a load of 7,776 pounds. It is one of Uncle Sam's bombing planes.



The first picture on the left shows what you would see if you were sitting in the pilot's seat. Those round things—most of them—are indicators that tell the pilot about such things as wind velocity, engine speed, altitude, gasoline and oil supply. The picture in the center shows what is known as Model K-T of a Dayton-Wright cabin cruiser. How trim and beautiful it is; and what a delightful arrangement to have all those windows in the passenger compartment, including the windows in the roof! It's a regular sun parlor on wings. The picture on the right shows a seat in a flying machine for carrying two passengers. In front sits the pilot with that control lever between his legs. This lever has four motions. When he pushes it forward the plane dips down; when backward, it soars; when he moves it to the right the machine tips or banks to the right, and vice versa.

Schroeder, who on Feb. 27, 1920, rose 36,020 feet near Dayton, Ohio. His eyeballs were frozen and he became unconscious as he reached this tremendous height; the machine started to fall, but after a drop of 2,000 feet the pilot recovered his senses sufficiently

to effect a safe landing. His altimeter, the instrument which measures altitude, had made an accurate record of his voyage above the clouds.

But greater than all these achievements are the airplane flights across the Atlantic. The dream of

every airman came true in May, 1919, when Lieut.-Com. A. C. Read of the United States Navy piloted the seaplane NC-4 from New York to Lisbon, Portugal, stopping in Newfoundland and the Azores Islands.

The machine left Newfoundland on May 17, and landed in the Azores in 15 hours and 13 minutes. Leaving the Azores on May 27, the plane flew to Lisbon in 9 hours and 43 minutes, completing the first transatlantic trip in 26 hours and 40 minutes actual flying time. Less than a month later this record was broken when the British flyer, Capt. John Alcock, and his American navigator, Lieut. Arthur W. Brown, "hopped off" from Newfoundland on June 14, 1919, and landed without hitch or stop in Ireland, 1,960 miles away, in 16 hours and 12 minutes.

These various achievements demonstrated conclusively that the war had brought the airplane to a high point of mechanical development and that as a flying device it was ready for commercial use. Consequently, attention turned to the other features of flight—landing fields, maps, and "air laws."

Today nearly all cities of importance in Europe and America are equipped with airplane landing fields, and governments are rapidly laying out aerial highway systems, with maps showing the landmarks, ground stations, and other facilities for official and private lines. Laws have been drawn up to govern air traffic and regulate

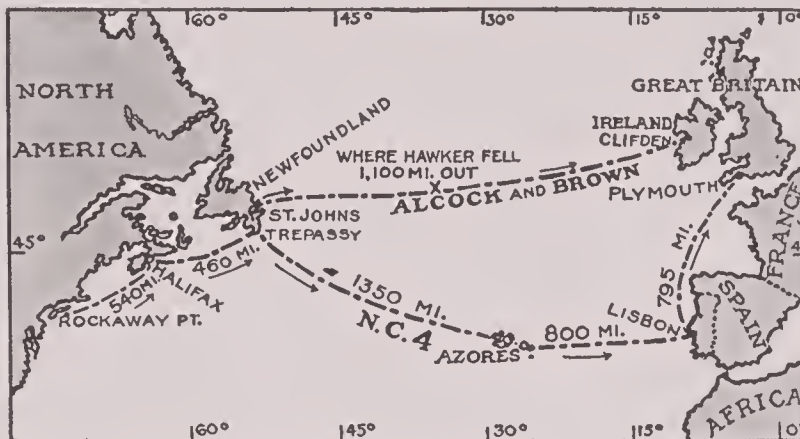
passage over international boundaries. The experience of careful flyers has proved that the dangers of air travel can largely be eliminated. With improvements in construction and stabilizing devices and with the

development of the parachutes, which enable pilot and passengers to float down safely when the machine beneath them falls, we may expect to see the number of fatal accidents progressively reduced.

The airplane needs neither roads nor rails. No stretch of water or wilderness can bar its way. The surveyor or engineer can view from the clouds the living map of the country where the future railway will pass. Life-saving crews can scout for vessels in distress. Forest rangers can detect forest fires miles away. The doctor, the missionary,

and the explorer can reach with ease the remotest haunts of savagery. The statesman and the man of business can visit distant points in person without the loss of precious time. If the progress of the world is to be measured, as a great man has suggested, by the agencies which bring men closer together, then the airplane has already won a high place in the history of civilization.

WHERE THE DARING AIRMEN CROSSED THE ATLANTIC



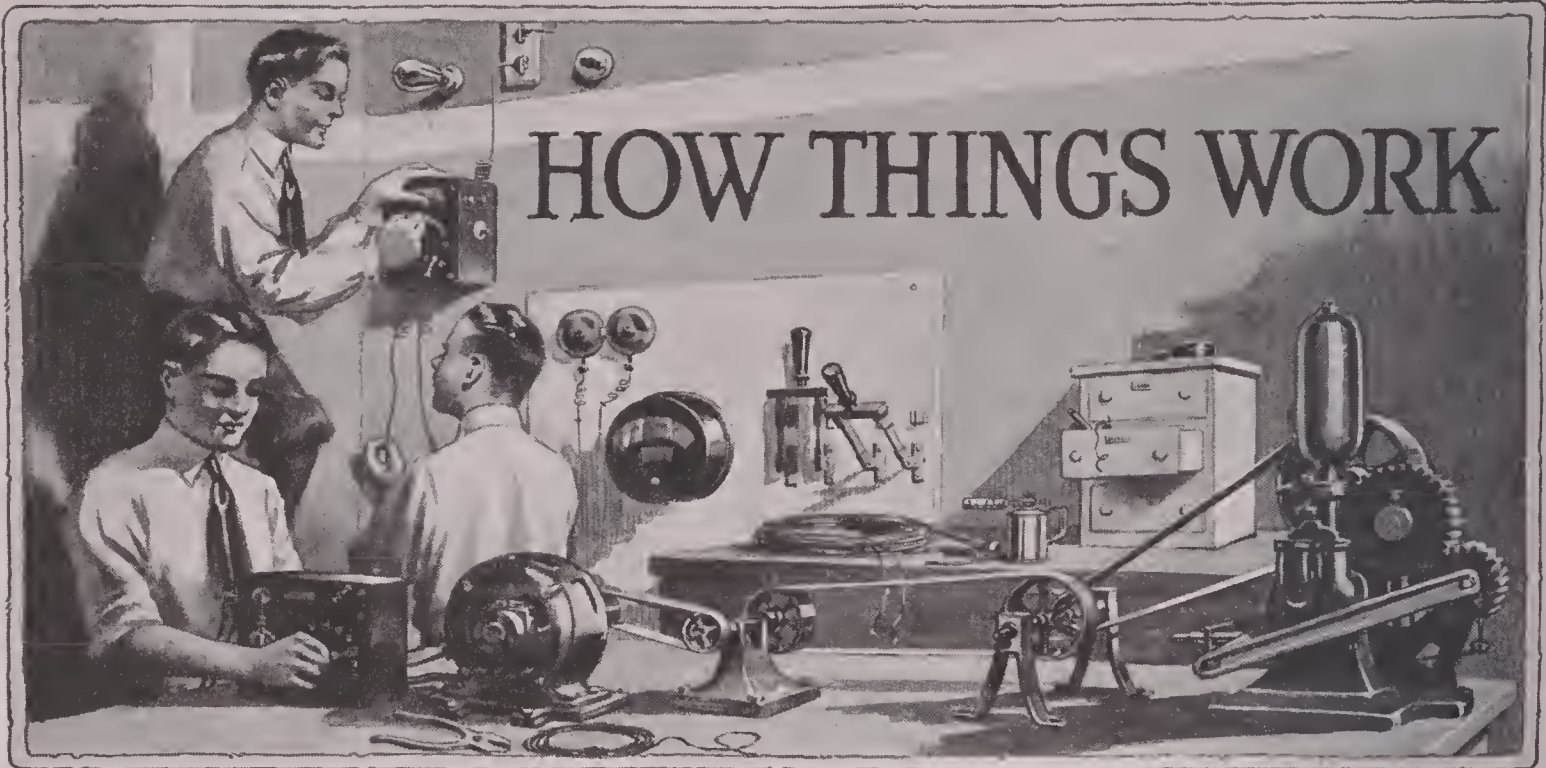
This map shows the routes of the first flights across the Atlantic. In May, 1919, the United States Navy seaplane, the NC-4, after flying from Rockaway to Halifax and from Halifax to Trepassey Bay, Newfoundland, flew to the Azores, and from the Azores to Lisbon, completing the journey on May 27. This was the first flight ever made by man across any of the great oceans. A few days later, on June 14, Captain Alcock and Lieutenant Brown "hopped off" from St. John's, Newfoundland, and took the route shown, completing the first "non-stop" flight across the ocean. Some time before, Harry G. Hawker, an Englishman, tried to cross, but fell into the water after traveling 1,100 miles. He was fortunately picked up by a passing vessel. An interesting incident of the flight of Alcock and Brown was that during a fog they turned over and sailed along with the machine upside down until they "looked up," and, as it seemed, saw the sea above them. Then they righted themselves.



THE FIRST MACHINE
TO FLY ACROSS THE ATLANTIC

Here we are looking at the famous NC-4 seaplane of the United States Navy, the first flying machine to cross the Atlantic. The thing about these seaplanes that enables them to float when at their moorings or when obliged to land in the water for a short time is the pontoon, on which you see a figure "4." On either side of the pontoon and suspended from the lower part of the biplanes are boat-shaped hollow floats that help the vessel to keep its balance in the water, for they prevent the wing from dipping under. Three seaplanes started on this historic air voyage, the NC-1, 3, and 4. The NC-2 was not completed in time. The NC-1 fell in the water and sank, but the crew were rescued. No. 3 "taxied" in on the water from some distance at sea to the Azores. The NC-4 flew all the way.

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How the Airplane Works

LEARNING to run an airplane requires no extraordinary skill. Any man or woman with good eyesight, cool judgment, and a "sense of balance" can acquire the art in a short time. The best and safest altitudes for flying are above 3,000 feet, because, if anything goes wrong and the plane starts to fall, the aviator has a better chance to get his machine under control again before it strikes the ground. The air currents are steadier also at high altitudes. The stability of a properly handled airplane was established for all time by certain daring American flyers who leaped down from one plane to the back of another,

One of the things we notice as we compare early ships with modern ships, early trains with modern trains, early motor-cars with modern motor-cars, is that the outline becomes more graceful all the time. It is not merely that men are trying to make these things look more beautiful, but that they find out by experience that graceful lines are usually the best lines possible for these vehicles. A round stone will glide through the air better than a square one; the air resists it less. And so what are called the "stream-lines" of an airplane are very important. Any rapidly moving object tends to leave an "air-hollow"



Fig. 1. The Graceful Lines of the Airplane

while the two were traveling among the clouds.

The following explanation and pictures will show that the methods of airplane construction and control are comparatively simple.

or vacuum behind it. When an airplane pushes its way forward, it finds itself pulled backward by the suction of the vacuum it creates. The problem is to enable the air pushed aside in front to flow away

For any subject not found in its alphabetical place see information

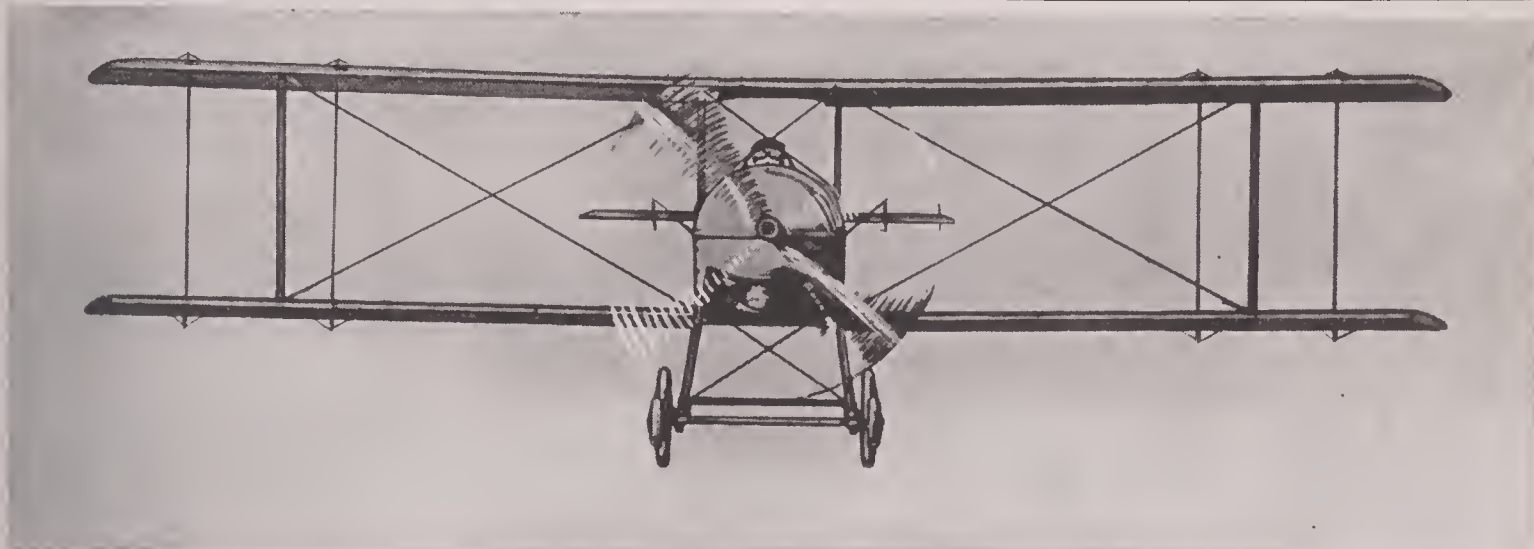


Fig. 2. The Airplane Comes Towards Us—the Flying Motor-Car Looking Almost Like Two Blades of Grass

behind the machine as smoothly as possible, and so the parts of the airplane are all rounded and tapered off finely to enable this to happen.

In Fig. 2 the airplane is flying directly at us as we look at it, the propeller being practically invisible owing to the high speed at which it is revolving. We see how splendidly constructed the airplane is for flying through the air so as to meet as little resistance as possible, and consequently to achieve the highest possible speed.

The structure of the airplane is shown in this skeleton (Fig. 3) of its principal parts. The small but powerful engine is fixed into a steel frame in front of the body, and the little projecting shaft in front of it carries the propeller. The engine shown here is of the rotary or "Gnome" type, which was specially invented for use in airplanes, and is still used in some of the fastest machines. The long central body of the airplane is here uncovered, and we see how it is built up of long rods, called longerons, which taper off towards the tail-end and are joined at the rudder. They are held in their places by cross struts fastened on with flat steel clips, and gripped by wires fastened from corner to corner, so that the whole body, called the fuselage, is put together in the style of a somewhat flexible boxlike girder. Part of one of the wings—also called planes or aerofoils—is given to show how they are

made; they are generally made so that they can be removed for convenience. The upper planes are fixed to the section over the pilot's seat. The spars and ribs of the wings give great strength with flexibility. The spars run the whole length. The whole framework of the wings and the fuselage

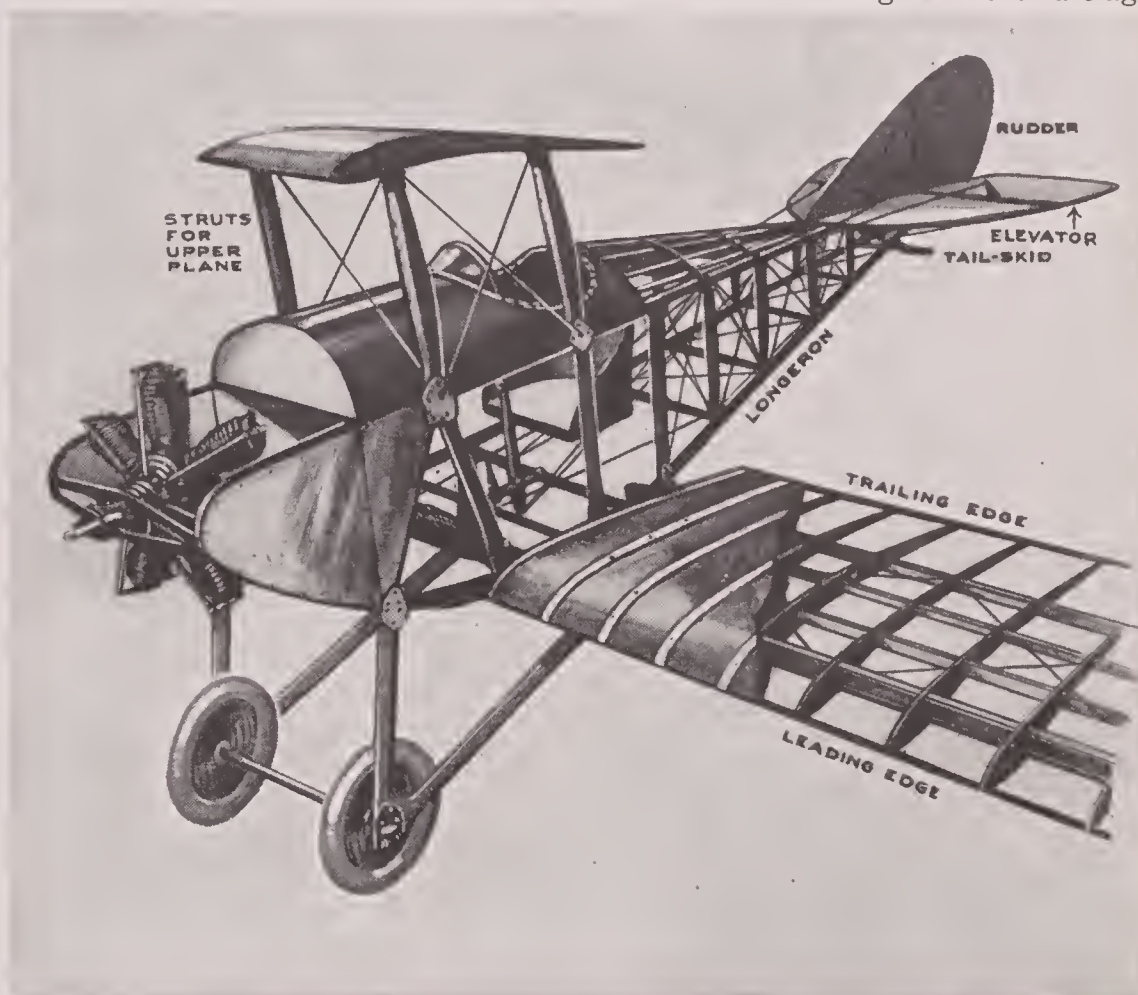


Fig. 3. The Skeleton Framework that Holds the Airplane Together—the Structure of a Biplane

is covered with strong linen painted with special varnish or "dope," which shrinks the cloth until it is drawn tight like a drum. It is proof against rain and snow and oil and gasoline. It is important that the wings should not be flat, and, as the word *plane* means "flat," it is a confusing word to use. The

wings really curve downward a little. But you will notice that the upper surface of each wing has a shape quite different from the lower surface. It curves up in a sort of hump before turning downward. This is to increase the vacuum which has so much to do with the lifting power of an airplane's wings. The air strikes this hump and is forced upward in a high curved arch, inside of which is the vacuum. The upper wings of a biplane are set farther forward than the lower wings, so the rush of air from their under surface will not interfere with the vacuum created by the planes beneath.

The framework of airplanes may be of spruce wood or of steel tubing. Experiments are constantly being made to construct all-metal planes, and at least one machine of this kind, a monoplane, has been very successful.

In the pilot's cockpit (Fig. 4) a man sits and flies for his life. All that the world means to him depends upon these handles and wires about him. Beside him, at his fingers' ends, is the little pump for keeping up pressure in the gasoline tank, and just in front of this is the lever controlling the sparking apparatus for starting or stopping the engine. In front of this is

gasoline. On the instrument-board in front is a clock on the left, then the air-speed indicator, then the gasoline and lubricating oil gauges, then the altimeter for showing the height, then the compass. In front of the pilot is the all-important control-lever,

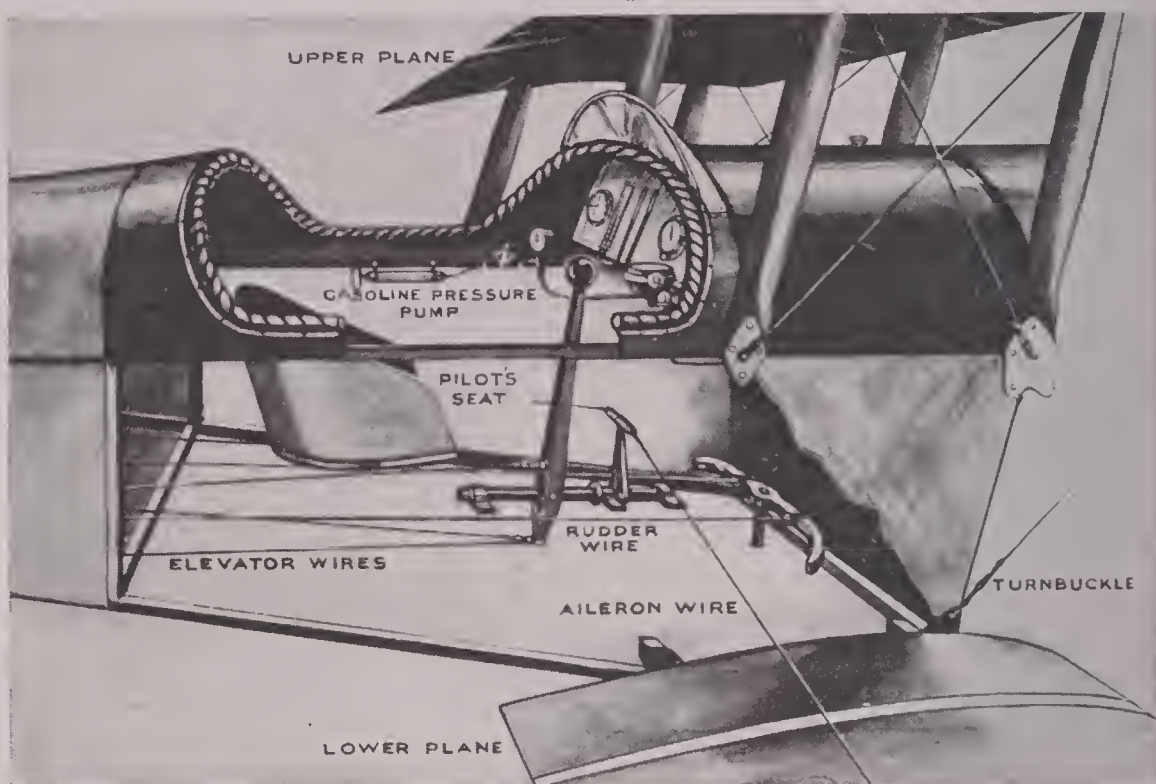


Fig. 4. The Pilot's Cockpit and the Instruments that Guide and Guard Him Through the Clouds

or "stick," which moves forwards and backwards and from side to side. Wires attached directly to it control the rise and fall of the airplane; its forward and backward movements control the elevators which govern the ascending and descending; and its side to side movements cause the lift and dip of the wings.

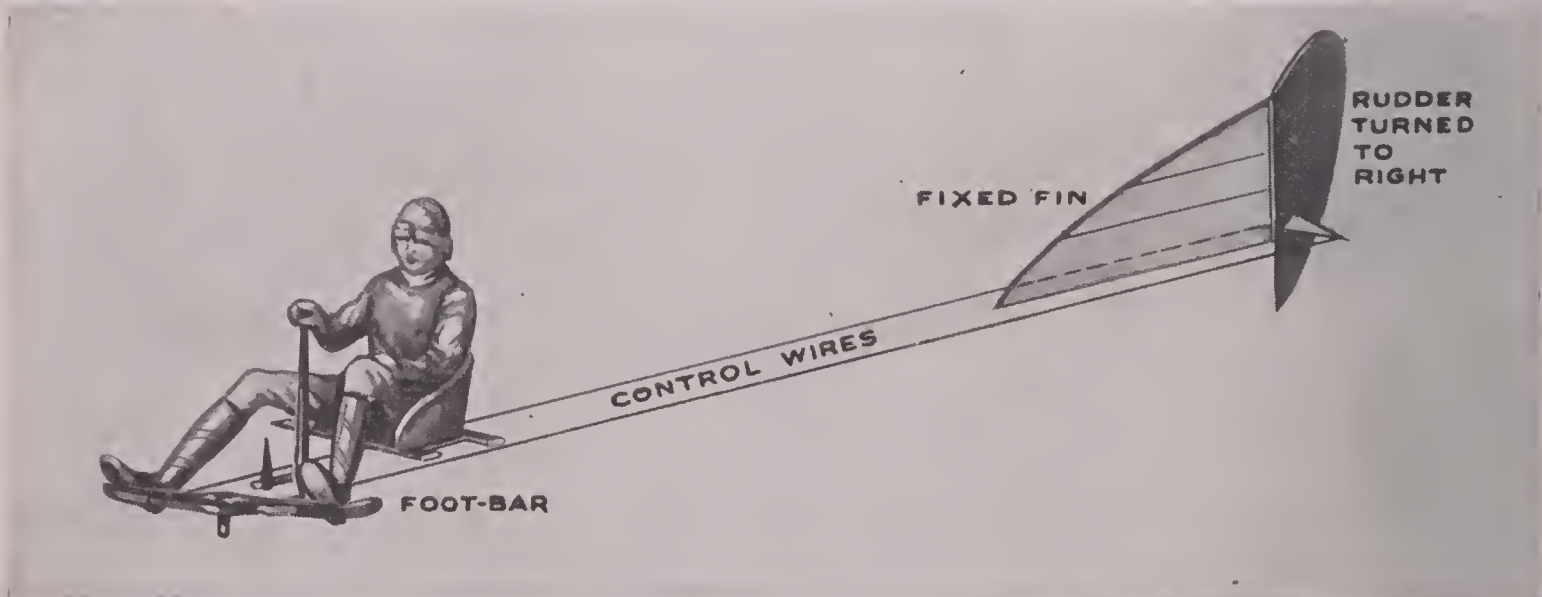


Fig. 5. The Rudder of the Airplane and How It is Controlled

the speed-indicator for the engine, called the "tachometer." It tells how many revolutions the engine is making each minute, the average being about 1,400. At the pilot's right is the throttle which controls the engine speed by checking or increasing the flow of

The foot-bar (see also Fig. 5) controls the rudder.

In Fig. 5 we see the working of the rudder, which acts like the rudder of a boat. The pilot here is pushing the rudder-bar with his right foot, so that the rudder turns to the right. The air pressure on the right side



Fig. 6. How the Airplane Turns Around—A Pilot "Banking"

of the rudder causes the tail-fin to move to the left, and the nose of the airplane turns to the right.

We have not yet realized how adaptable the air-

the need may be. At each end of the wings is a movable flap such as we observe in Fig. 7. They are called ailerons, and their business is to act as

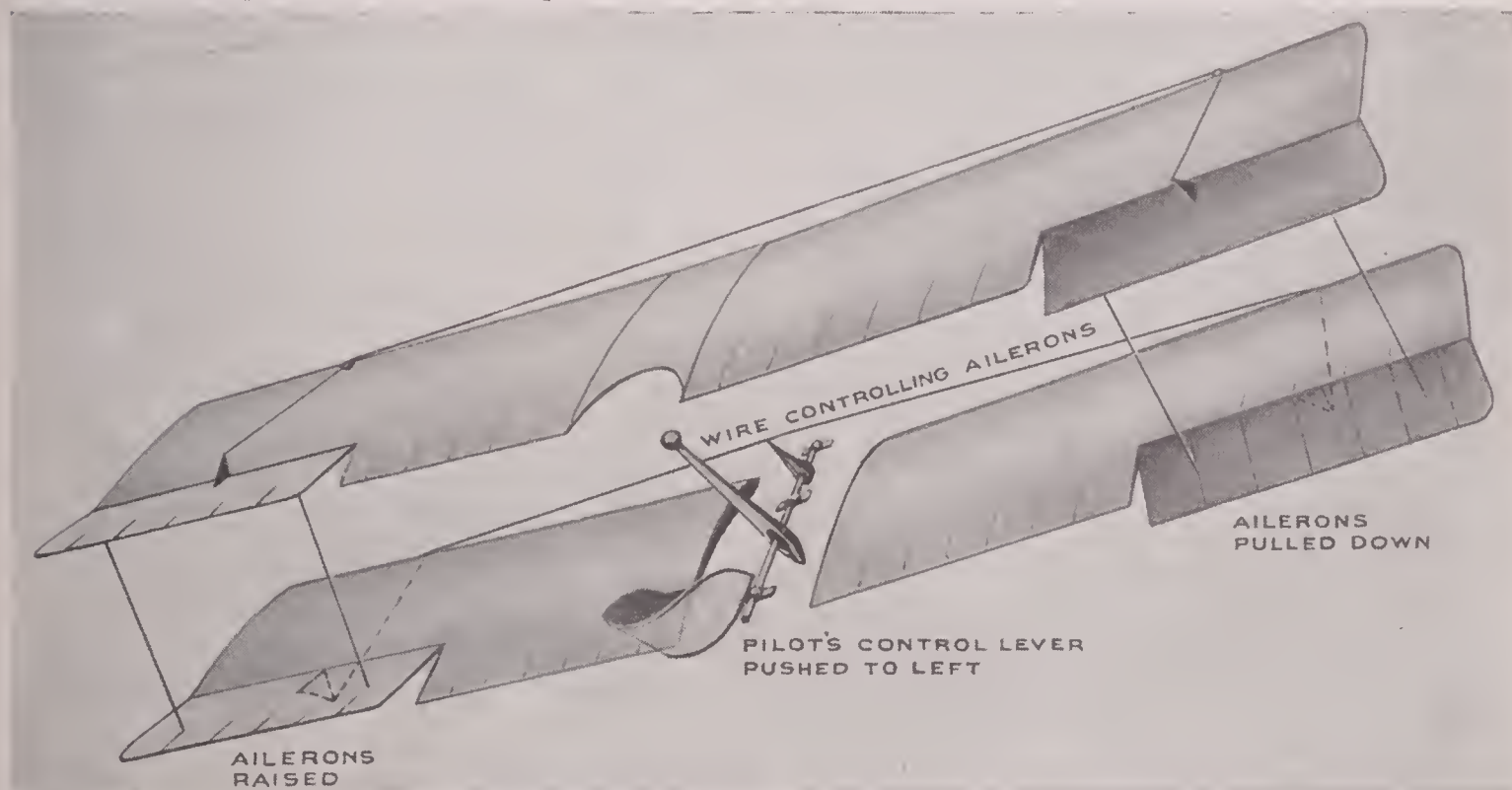


Fig. 7. The Method of Controlling the Wings in Banking to the Right

plane must be to the call of the wind. It must be fine and strong in all its parts, it must be smooth and easy against the air, it must be rigid or flexible, as

rudders to the neighboring parts of the wing. They are worked by the side-to-side motion of the control lever, and they are all-important in the difficult busi-

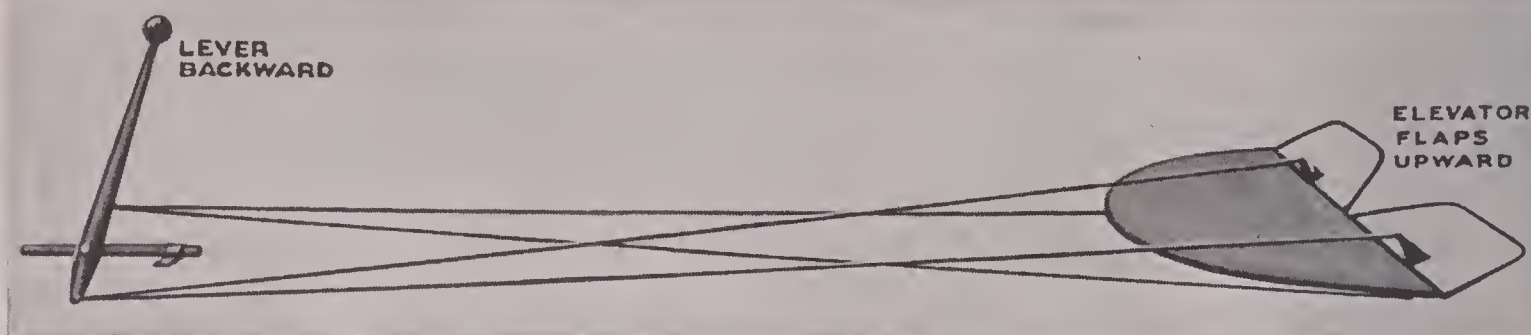


Fig. 8. The Pilot Ascends—How the Elevator Flaps are Pulled Up

ness of what is called "banking" in the air (Fig. 6). As the airplane turns to the right, the left wing rises while the right wing drops. The machine is "banking to the right." Unless the movement is accompanied by turning the rudder also to the right, the machine will "side-slip" toward the ground, just as it will "skid" if the rudder is turned without banking. Both movements are necessary to a proper turn.

Figs. 8 and 9 show how the aviator makes the machine ascend and descend. When the control-lever is pulled backward (Fig. 8) the crossed wires pull up the elevator flaps at the tail of the machine. This forces the tail down, so that the nose of the airplane points upward and the machine rises. In Fig. 9 the reverse process is shown.

We should note in Fig. 10 how the tail-fins and the rudder are made. This picture gives a closer view of the rudder with the cover off. The rudder is the piece on the right, and it is worked by wires operated

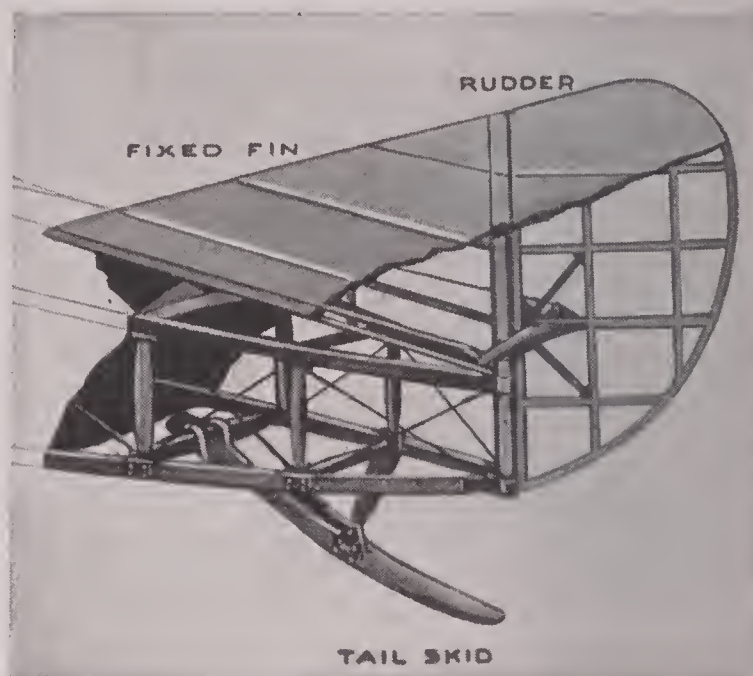


Fig. 10. The Rudder

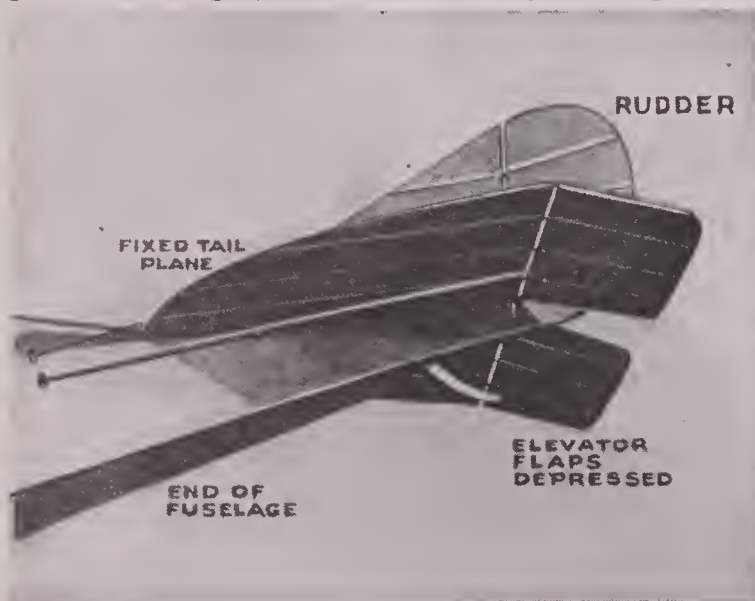


Fig. 9. The Pilot Descends—How the Elevator Flaps are Depressed

from the pilot's seat. It swings on the steel stern post at the end of the fuselage, where the upper and lower pairs of longerons meet. Below, attached to the lower longerons by steel springs, is a protecting skid, upon which the tail is safely supported when the airplane comes down.

An airplane is like a man—it must be fit if it is to do its best. All its parts must respond instantly to the touch of the pilot, and the "tuning up," as the

men call it, is exceedingly important. Jolting over uneven ground and the stress and strain of flight may

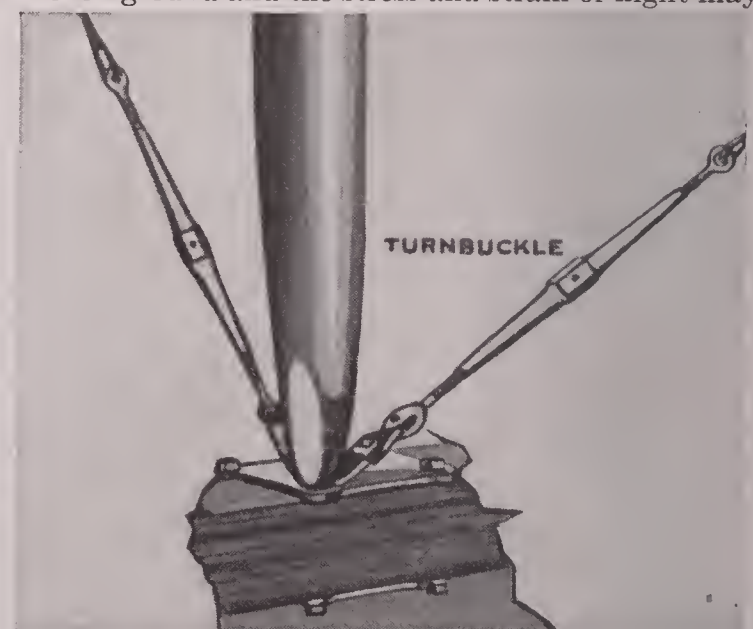


Fig. 11. Turnbuckles for "Tuning Up"

loosen important wires, which must be tested and tightened before every flight. Each wire, therefore, is provided with what is called a turnbuckle, as shown in Fig. 11. This fragment shows two turnbuckles attached to guy-wires on both sides of a strut resting on a spar supporting the upper wing.

AIR PLANTS. Plants which attach themselves to trees or other support instead of growing from roots in the ground are called air plants (*Epiphytes*). Unlike parasitic plants, they obtain no food from the object on which they are seated, but depend on the dust that blows and collects about them, and on the moisture from the dews, fogs, and rains. This peculiar habit has led to the mistaken popular belief that they live on air alone. The work of gathering water is generally performed by the leaves.

Most air plants live in the tropical regions of the earth, especially in the warm moist shady forests along the Equator. Sometimes the trees of such a forest are so covered with them that their trunks and branches are entirely hidden. Most of the air plants in these regions are bromelias, orchids, and ferns (see Orchids). In the northern latitudes the group is represented by such small forms of plant life as the mosses, liverworts, and lichens.

One of the best known of the wild air plants is the Spanish moss of the southern United States. It is not a moss, however, but one of the bromelias, a true seed plant. It hangs in long gray masses from the branches of trees.

AISNE (ān) RIVER. When a big man attacks a little man, expecting to beat him easily, and finds that unexpectedly the little man not only stands up to the attack but even hurls back his assailant, what should the big man do? This was the question that presented itself to the Germans in France, in 1914, when they had been pushed back by the first battle of the Marne and found themselves at the Aisne River. They could not go forward and they would not go back. Yet the cost in men of open warfare was too great to be met. So they did a thing which altered the whole conduct of the war; they dug themselves into the ground. Perhaps the character of the hills beside the Aisne River, which are rugged and pierced by many stone quarries, suggested the idea to them. The French, facing them across the shallow river, were forced to do the same. And there they stayed.

Yet each side, finding itself held on this line, tried to outflank the other, to get around the end of the fortified ground. To prevent this it was necessary to extend the systems of trenches farther and farther, at first northward to the sea and afterwards southward to the Swiss border, so that in a short while the whole line across France was set rigidly—"stabilized" they call it—because of this battle of the Aisne.

This was the beginning of the trench warfare that lasted four long years and accomplished so little. In the spring of 1918 the Germans, seeing no end to this bloody situation, made a desperate attempt to break through again and reach Paris. They struck first to the northward. Then, being held there, they began the second battle of the Aisne. Again they passed the river and reached the Marne, at Château-Thierry. And again the French, this time with the aid of American troops, turned them back. But this time the Germans, having started to retreat, could not stop

at the Aisne, but were swept clear out of the valley and soon afterwards clear out of France in the final victory for the Allies.

So the Aisne River, although it is a narrow shallow stream only 175 miles long, is now one of the famous rivers of the world, and its valley the last resting place of many thousands of brave soldiers. It flows along the western edge of the Argonne Forest, where the Americans fought so gallantly. Then it turns westward, passing north of Reims, where it gathers up the Vesle River, runs through the city of Soissons, and empties near Compiègne into the Oise, and so into the Seine. As a river it is quite unimportant, but so long as the World War is remembered the Aisne River will be a symbol of blood and of heroism.

A'JAX. Next to Achilles in strength and bravery among the Greek warriors was Ajax, the son of Telamon, known as Ajax the Great. He led the men of Salamis in 12 ships against Troy. Homer in the 'Iliad' describes him as of gigantic stature, "shaking his far-shadowing spear" and bearing his "tower-like shield of bronze, overlaid with sevenfold ox-hide." He was the "bulwark of the Greeks" and struck terror into the hearts of the Trojans. At the death of Achilles, Ajax as the bravest of the Greeks claimed his armor, but he was forced to contend for it with Odysseus (Ulysses), and the latter won the prize. So enraged was Ajax that he went insane and killed himself. The story of his madness and death is told by Sophocles in the tragedy 'Ajax'.

Another Greek hero who bore the same name was the son of Oileus, king of Locris, and was known as the "lesser" Ajax. He was small of stature, but was brave and skilled in throwing the spear, and was next to Achilles in swiftness of foot. He was boastful and arrogant, however, and was punished for defying the gods by being wrecked and drowned on the return voyage from Troy. Like the Telamonian Ajax, he was the enemy of Odysseus.

AKRON (āk'ron), OHIO. Out of the smoke of vast factories, through wide straight streets flanked by the comfortable homes of thousands of workmen, winds the "romance of rubber," which is the life of the great industrial district of Akron, Ohio. Not that Akron lives by rubber alone, but that this is the big distinctive industry which makes Akron the "rubber capital" of the world and tripled its population between 1910 and 1920.

The tires on which bicycles and automobiles run, the hose that extinguishes fires and waters our gardens, the band that snaps around your note-book, the elastic tissue that the dentist fits painfully around your tooth, the giant bag of the army balloon—all were born under the Equator, but adapted to man's use in Akron, Ohio. Other important industries of Akron are the manufacture of clay products, cereals, motor trucks, implements, and fishing tackle.

Akron is situated 35 miles southeast of Cleveland on the Ohio Canal. Surrounding this busy industrial center is a region of great natural beauty, dotted with many small lakes. The town was settled about 1818, but its growth dates from the building of the canal in 1825. It was once the home of John Brown, the abolitionist. Population, about 210,000.

The HEART of the NEW INDUSTRIAL SOUTH

ALABAMA. The "Cotton State," as Alabama is sometimes called, is one of the five Gulf States, lying between Mississippi on the west and Georgia on the east. It is separated from Tennessee on the north by the 35th parallel. To the south lies Florida, except for a strip 50 miles long which extends to the Gulf of Mexico and includes Mobile Bay. Some writers say that the name *Alabama* is an Indian word meaning "here we rest," others that it is another form for *Alibamu*, a tribe of Creek Indians who once inhabited the state.

The climate and the rich black soil of Alabama are favorable to the growth of a wide range of agricultural products, and before the development of its vast mineral resources Alabama was chiefly an agricultural state. Even today more than half the area is farmland, and cotton is the most valuable product. Other important crops are corn, oats, wheat, hay, peanuts, tobacco, potatoes, and sugarcane. Fruits, melons, and other vegetables are cultivated extensively in the uplands, and the foothills of the northeast afford excellent pasturage. Cattle and hog raising, until recently neglected, is becoming an important source of profit. Near the Gulf, oranges and other citrus fruits are beginning to be cultivated.

The iron and coal industry of Alabama is of great economic importance. In the north central part are rich deposits of iron and coal, which rank among the most important in the United States. The coal formations, which cover more than half the state, were discovered as early as 1834, and since 1880 many extensive mines have been opened. This is the southern end of the coal area of the Appalachian coal region, which includes the great coal fields of Ohio and Pennsylvania; and Alabama now ranks high in coal production. In the production of coke Alabama ranks second among the states. Extensive

Extent.—North and south, 336 miles; east and west, 200 miles. Area, 51,998 square miles. Population (1920 census), 2,348,174.

Natural Features.—In north and east, mountains (Lookout and Raccoon Mountains, continuation of Appalachian system, highest elevation 2,500 feet) descending into rolling uplands (Cumberland Plateau and Piedmont region) to northwest and southeast; in center and south, coastal plain. Chief rivers: Mobile, formed by junction of Alabama and Tombigbee; Tennessee River (crosses the northern part of the state); Chattahoochee (part of boundary with Georgia).

Principal Cities.—Birmingham (population 180,000); Montgomery (capital, 45,000); Mobile (chief seaport, 60,000).

Chief Products.—Cotton and cotton goods; iron and steel; coal and coke; lumber and timber products; corn, cereals, fruits, and tobacco.

deposits of iron ore occur in close proximity to the coal; and the great advantage of these great coal and ore deposits lying so close together has within the past 30 or 40 years brought Alabama from a purely agricultural state to one of the chief manufacturing sections of the country with Birmingham as its center. In North Birmingham is one of the few large puzzolan cement factories in the United States.

Excellent marbles in a variety of colors occur in large quantities, and deposits of limestone, chalk,

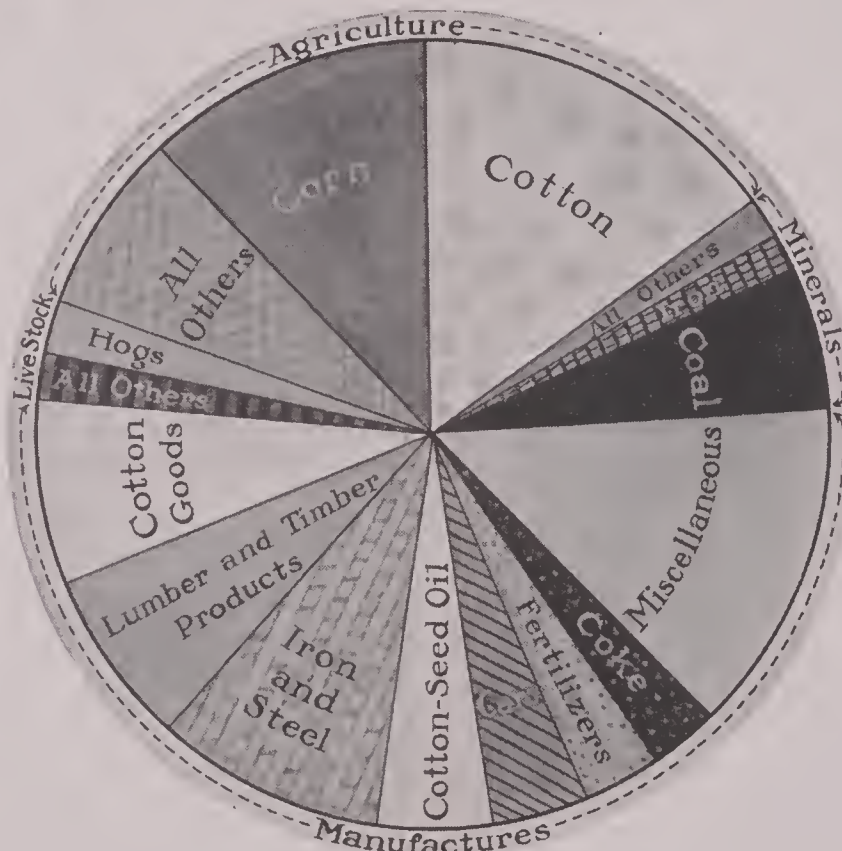
clay and shale suitable for the manufacture of cement exist throughout the state. About one-half the graphite mined in the United States is produced in Alabama, and there are valuable deposits of bauxite, from which aluminum is made. Porcelain clay, tile and building clays, slate, asphalt, phosphate silica, fuller's earth, barytes, mineral waters, natural gas, and petroleum occur in small but paying deposits.

Alabama is made up of three great regions—the coastal plain, the piedmont or upland region, and the mountains. In the northern and east central part, where the Blue Ridge of the Appalachians has its southern ex-

tremities, the scenery is diversified and picturesque. The mountains take the form of flat-topped hills, which at no point exceed 2,500 feet, and terminate in foothills and sand mountains toward the center of the state. The most prominent are Raccoon and Lookout mountains. It was on the northern end of Lookout Mountain that one of the great battles of the Civil War was fought.

To the east and south of the mountain region is the piedmont region of rolling uplands, and to the northwest is the southern end of the Cumberland Plateau, which is broken into flat tablelands by the valley of the Tennessee River and other rivers. In

ALABAMA'S WEALTH FROM SOIL, MINE, AND FACTORY



The distribution of Alabama's chief products according to value is shown in this chart. The state's marvelous industrial progress in recent years has put its manufactures slightly ahead of its farm and mine products combined, but even today Alabama is one of the greatest cotton-growing states.

WHERE ALABAMA'S RICHES LIE



Birmingham a Great Steel Center

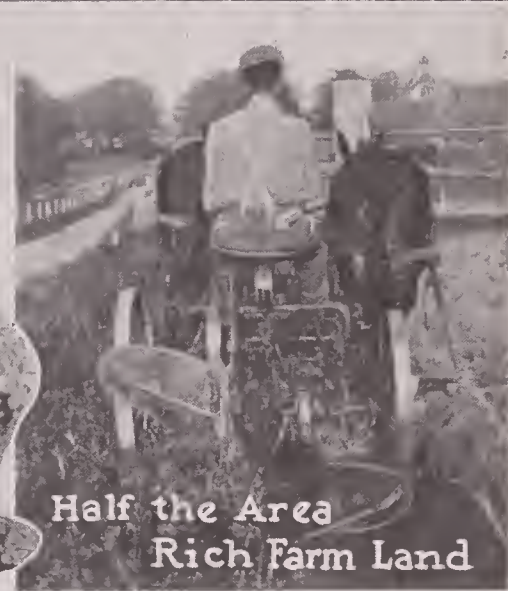


One of the Many Large Coal Mines



Bumper Cotton Crops

Marble of Fine Quality



Half the Area Rich Farm Land



State Capitol at Montgomery



Morgan Hall, University of Alabama



A Great Variety of Products from Farm and Field

Building Clay

Cement

The wealth, the industrial and educational enterprise, and the high civic spirit of Alabama are here typified in a few examples. These pictures speak to the eye of her rich soil, her marble quarries, her coal mines, the great steel mills at Birmingham, the cotton which she not only raises but weaves into cotton cloth in her many busy factories. Every variety of product of orchard, garden, and field is grown in this genial climate.

contained in the Easy Reference Fact-Index at the end of this work

this varied region of hills and valleys lie the coal and iron deposits.

The remaining three-fifths of the state belongs to the coastal region. Across the center where northern upland and southern plain come together lies a belt of rich dark soil of great depth and fertility. This is the famous Black Belt, where the great fields of cotton are grown, although cotton is produced more or less in all parts of the state. South of this the coastal plain slopes gradually to the southwest, with limestone ridges, sometimes 10 or 12 miles wide, at irregular intervals. Extending back 150 miles from the Gulf are valuable timber lands, of long-leaf yellow pine and other woods, which supply not only lumber, but tar, turpentine, and resin.

The numerous rivers, never closed by ice, afford 1,500 miles or more of navigable stream. In mileage of navigable waters Alabama is richer than any other southern state, and it is one of the four great river states in the Union. A prosperous commerce was developed in the rivers at an early date. The Tennessee, which is navigable everywhere in Alabama except near Florence—and there a canal has been built around Muscle Shoals—gives an outlet to the Ohio, and the enormous water-power of the Muscle Shoals, when fully developed by great dams and other works, will afford a source of hydroelectric power whose potentialities are as yet little realized.

The construction of great government nitrate plants here during the World War was the beginning of a long-cherished project to make Muscle Shoals the "Niagara of the South."

The chief river basin of the state is the Mobile, formed by the junction of the Alabama and Tombigbee rivers, both sluggish, crooked streams which

join about 45 miles from the sea and empty into Mobile Bay. This bay forms one of the best harbors of the Gulf of Mexico, and the government maintains a 30-foot channel through the 36 miles of its length.

About one-half the boundary between Alabama and Georgia is formed by the Chattahoochee River. The Perdido River separates the lower part of Alabama from Florida and empties into Perdido Bay, which was formerly a famous resort of pirates and filibusters.

Most of the great railway systems are in the northern part of the state, where they tap the mineral deposits. Alabama was one of the pioneer states in railroad building and had the first system west of the Allegheny Mountains, built in 1830. The rails were iron bars laid on wooden stringers and the cars were drawn by mules.

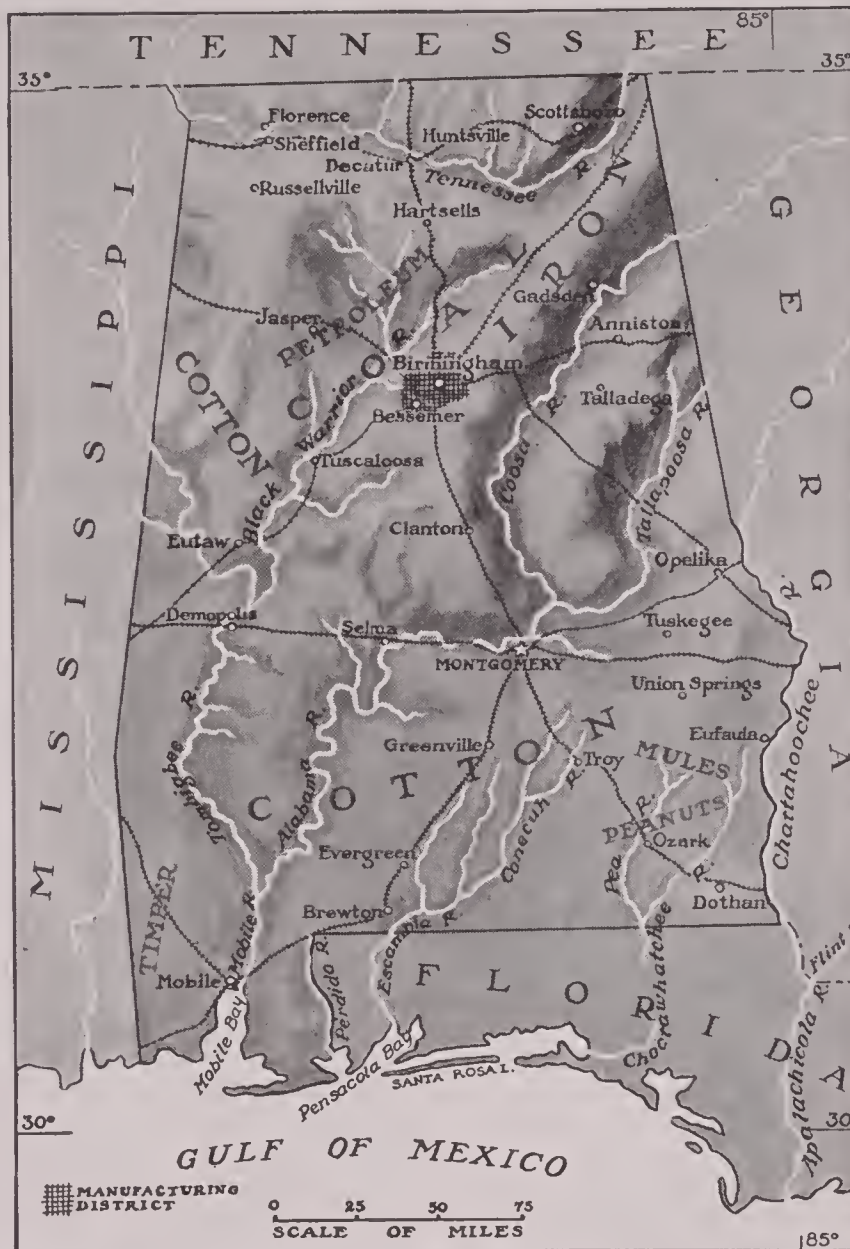
The climate of Alabama, although warm, is especially delightful in the northern mountainous regions. Snow falls only occasionally, but there are heavy rainfalls usually in February and the months just following.

The population of Alabama has advanced steadily but not rapidly since its admission to the Union in 1819.

Over 80 per cent live in rural districts. After Birmingham the largest cities are Mobile and Montgomery. Alabama has long been notable for the small number of its foreign-born inhabitants, but the number has increased with the advance of manufacturing. Today Alabama is not merely a great iron and steel manufacturing state, but is also an important center for cotton manufacture, ranking fifth in the amount of cotton used. Besides iron and cotton goods, the principal manufactured products are lumber, cottonseed oil and cake, fertilizers, turpentine, resin, brick and tile.

Separate schools are maintained for the white and colored children and the public fund is applied in

RELIEF MAP OF ALABAMA



Principal Religious Denominations

Baptist

Methodist

All Others

Snowing highlands and lowlands, rivers, chief railroads, chief cities, and production areas. The chart below indicates the relative strength of the principal religious denominations.

proportion to the two classes of schools. There are six state normal schools for whites and one for negroes. The state university is located at Tuscaloosa, and at Auburn is the Polytechnic Institute. Tuskegee Institute for the education of negroes (coeducational) is one of the largest educational institutions in the state and the largest in the world for negroes.

The History of Alabama

The Spaniard De Soto had crossed the state in 1542, with his knights, priests, and crossbowmen, when searching for the storehouse of wealth which tradition said lay to the west of Florida. The first settlement was made at Mobile Bay, in 1702, by the French under Sieur de Bienville, called the "Father of Alabama." But the early settlers were adventurers, not laborers, and the French colony did not succeed until after 1721, when three slave-ships brought slaves to Mobile. The French title was ceded to Great Britain in 1763. Many English and Scotch settlers were found before the Revolutionary War in this region, which was included in the English colony of Georgia, founded in 1732. In 1779 Spain seized the Mobile country, to which it had claims. Spain's title was finally disposed of in favor of the United States in 1813. The Territory of Alabama was organized in 1817 and admitted as a state two years later.

During the War of 1812 the whites at Fort Mims, near the junction of the Alabama and Tombigbee rivers, were massacred by Creek Indians. General Andrew Jackson a few months afterwards attacked the Creeks in their fortified position on the Tallapoosa, 20 miles north of Montgomery, and almost annihilated the tribe. Afterwards a treaty was made with the surviving Indians by which most of their tribal lands in Alabama and Mississippi were surrendered.

Alabama seceded from the Union on Jan. 11, 1861. Montgomery was the first capital of the Confederacy and Selma was made the leading Confederate arsenal and ship-ping yard. The Tennessee Valley was occupied by Union forces early in 1862. The Confederate fleet in Mobile Bay was destroyed by Farragut in 1864 and the forts retaken, and the whole state was reoccupied in April 1865. The "carpet-bag" rule which followed almost bankrupted the state; but these conditions have long since passed away.

Alabama has had six constitutions. The sixth and last constitution, framed and ratified at the polls in 1901 after severe opposition, practically disfranchised nine-tenths of the negro voters through what is known as the "grand-father clause" and other provisions.

'ALABAMA' CLAIMS. The steam cruiser *Alabama*, built in an English shipyard, was allowed through the negligence of the British government to put to sea (July 29, 1862) in spite of warnings by the American minister, Charles Francis Adams, that it was intended as a warship for the Confederate government. For two years the *Alabama* ranged the oceans, destroying Northern merchantmen, until it was finally sunk by the United States cruiser *Kearsarge*, on June 19, 1864. After long discussions, the British government agreed to submit to arbitration the claims to damages arising out of the *Alabama* case. The five arbitrators met at Geneva, Switzerland, in December 1871. After hearing evidence they decided that Great Britain had not exercised "due diligence" in permitting the *Alabama* to escape, and awarded to the United States \$15,500,000 damages. This ended a dispute which threatened to disturb the friendly relations between the two countries. It was also a great victory for the principle of the peaceable settlement of international disputes by arbitration (see Arbitration).

ALAMO (ā'lā-mō). A fortified Franciscan mission in what is now San Antonio, Tex. Here, about 180 Texans were besieged by a Mexican force from Feb. 23 to March 6, 1836, and all but six (three women, two children, and a negro boy) perished. (See Texas.)

AL'ARIC (370?-410). For 800 years—since the days of Brennus and his Gauls—Rome had not known the tread of a foreign conqueror. But again a barbarian foe, the mighty hordes of Alaric the West Goth, flushed with 15 years of plundering, was thundering at the gates of the imperial capital.

For a hundred years the might of the empire had slowly ebbed, while fierce tribes from north of the Danube wrought their will within its borders. Honorius the feeble Emperor of the West had now shut himself within his marshy fastness of Ravenna, wasting his time on the care of pet chickens.

Stilicho, Rome's ablest general, though himself of barbarian blood, had twice checked the invader, once in the heart of Greece and again six years later on the banks of the Po in northern Italy. But Stilicho was now treacherously done to death by the cowardly Emperor's orders, and Italy—and Rome—were defenseless.

The people of Rome, facing starvation within their walls, tried to buy the German leader off. The ransom he demanded was so high that they said they could not pay it, and they threatened the Goth with their numbers. "The thicker the hay," said Alaric grimly, "the easier it is mowed." They persuaded him to reduce his demands to 5,000 pounds of gold, 30,000 pieces of silver, together with gifts of pepper, scarlet skins, and silken tunics; and the siege of the city was lifted. When the Emperor safe in his swamp-protected retreat failed to pay the promised treasure, Alaric again besieged Rome. Treacherous to the last, Honorius employed a barbarian chieftain to attempt a surprise attack on the Goths. This failed, and for the third and last time Alaric was before the walls of the Eternal City.

The Goths soon entered (410 A.D.), and for three days that city which had been "mistress of the world" was given over to plunder. The shock of its downfall ran through the whole world.

Of the royal race of the Visigoths, or West Goths, Alaric had been elevated upon the shield and acclaimed king by his people, then living in ancient Thrace, in the year 395. Past the gates of Thermopylae and into the heart of Greece this fiery young chieftain had led his people, leaving its cities "like the bleeding and empty skin of a slaughtered victim." For five years he had then tarried in Illyricum, on the eastern shores of the Adriatic, re-equipping his men and preparing for more adventures. About the year 400 he first led his nation to the assault of Italy. The fall of Rome came in 410 A.D. Alaric died the same year while in southern Italy, planning to lead his troops to further conquests in the island of Sicily. According to legend his followers turned the River Busento from its course, and forced captives to dig a grave in its bed, wherein Alaric was buried. That no man might discover the tomb of their king the river was returned to its channel and the captives killed. Few men have had a stranger life than Alaric, and none a stranger burial. (See Goths.)

AMERICA'S TREASURE HOUSE of the North

ALASKA. The Purchase of Alaska by the United States from Russia for \$7,200,000 aroused a storm of indignation and ridicule. Nothing could be more foolish, it was argued, than to pay out good American gold for a mass of glaciers and frozen waste, as Alaska was then supposed to be. "Seward's folly" became a byword, but the man who made the purchase—William H. Seward, then secretary of state—regarded this act as the greatest service of his life.

Vast Profits on the Purchase

Gold, it is true, was not found till a dozen years later, nor in profitable quantities for a generation. But since then more than forty times the purchase price has been taken out of the land in gold alone, and the country has yielded a profit equally great from many other products. In 40 years the fur seals have yielded over \$50,000,000. The value of fish products, chiefly salmon, has been in some years as high as \$60,000,000. Alaskan copper deposits are probably the richest and most extensive in the world, great enough to furnish the world's entire supply.

Coal, as yet, is mined for local use only, but it is reported by the government survey as lying in seven veins, one above another, 250 feet deep. There are 150 billions tons at the very least, more than the original supply of Pennsylvania, and this takes no account of what coal there may be in two-thirds of the country, which has never been prospected.

What would be a fair price for Alaska today? Nobody knows, but if Russia still owned the territory there is no doubt that she could demand at least 1,000 times more than she obtained in 1867. It is not even possible to guess what great and valuable quantities of precious and semi-

Extent.—North and south, about 1,500 miles (latitude 54° 40' to 71° 30' N.); east and west (including Aleutian Islands), more than 5,100 miles. Area, 590,000 square miles (one-sixth of the United States). Population, about 29,000 whites; 26,000 natives.

Natural Features.—Chief mountains: Coast Range, Chugach Mountains, Aleutian Range, Alaskan Range, Endicott Range. Highest peaks: Mt. McKinley (20,464 feet), Mt. St. Elias (18,024 feet). Chief river: Yukon (length, 1,500 miles).

Principal Towns.—Juneau (capital), Fairbanks, Anchorage, Nome, Douglas, Sitka.

Chief Products (in order of value).—Salmon, copper, gold, furs.

precious minerals remain to be wrested from the earth; but that there are large deposits of tin, lead, zinc, tungsten, chrome ore, sulphur, and silver is known. Petroleum is probably there in vast

quantities, only awaiting government permission to be used; and water-power from swift glacial streams can be developed in unlimited quantities and transported as electricity to distant fields.

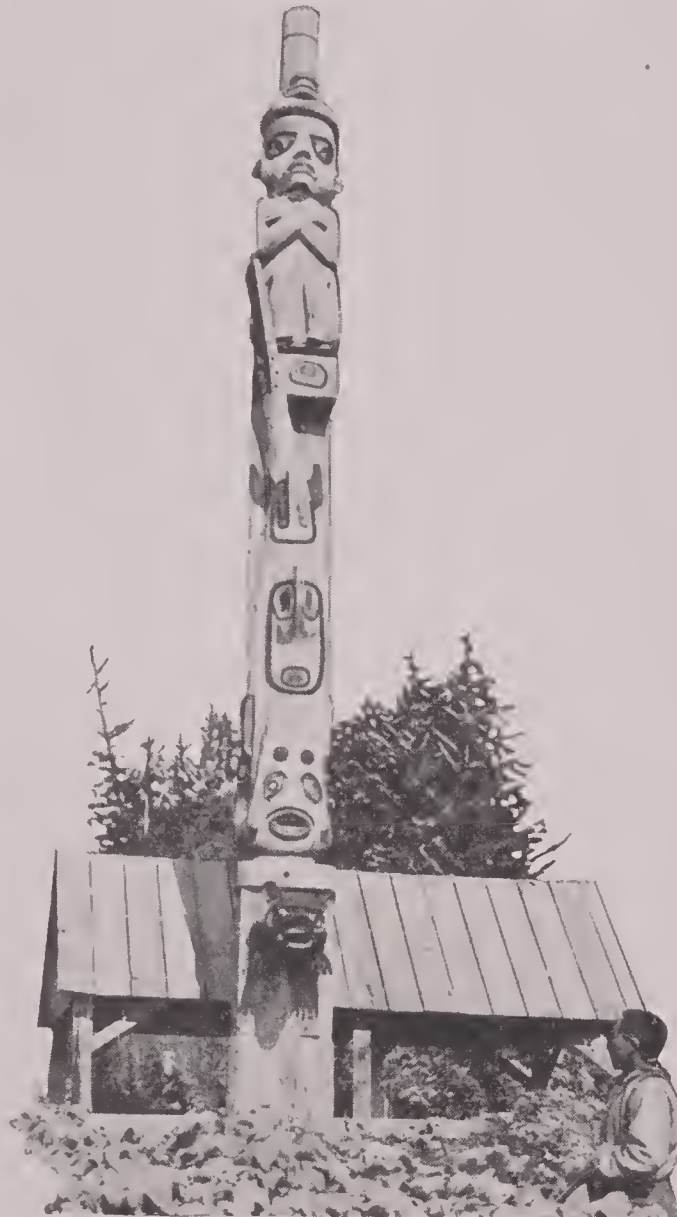
The fur seals, which for years furnished a revenue nearly as great as the gold mines, were threatened with extermination for a time, until the government in agreement with other nations placed severe restrictions on their destruction. These seals inhabit

four barren islets in the Bering Sea belonging to the United States known as the Pribilofs, and they are now watched and counted nearly as carefully as if they were human beings. In 1912 there were enumerated about 215,000; at the present time, as a result of restrictions on the killing, there are over 500,000.

Forests of spruce sometimes as much as six feet in diameter and 200 feet high are important for ship-building, while great areas of smaller-sized timber will help to solve the paper problem. There are blueberries for a nation's jam, strawberries taking first prize from the whole Pacific coast, and charming wild flowers that recall to the tourist the fate of the Russian discoverers who were threatened with imprisonment for talk about "plants growing on ice."

These things, at 60 degrees north latitude, are perhaps more striking than the great glaciers, mountains, and rivers. They mean that grains and vegetables and grasses—enough to feed any future population—can be profitably grown; for, like Norway, Alaska is a land of the Midnight Sun,

AN ALASKAN TOTEM POLE



His tribal totem is to an Alaskan Indian the animal symbol of the group to which each belongs. Thus it has something of the relation of the Tammany tiger or the Republican elephant to a zealous party member in the United States. To the Indian, the tribal totem stands for the animal ancestor from which he believes his tribe is descended; it is connected with all his religious and social beliefs. Totem poles are used as monuments of important events and tombstones of the dead.

MAP STORY OF ALASKA



The pictured map at the top shows graphically the chief natural features and some of the events in the history of Alaska. Bordering the Gulf of Alaska you see the magnificent mountain ranges which rise in many places precipitously from the sea. North of this Pacific coastal region, with its many splendid harbors, is the broad Yukon plateau. In the far north is the great Endicott Range, whose foothills rise from the coastal plain bordering the Arctic Ocean. With the aid of the dotted lines you can trace the memorable voyages of Capt. Vitus Bering, an officer in the Russian navy who in 1728 discovered the strait that bears his name; and of Captain Cook, who in 1778 surveyed the coast almost continuously as far as Seward Peninsula. The sketch map below shows the location of the chief cities, rivers, and production areas. At the right is a chart showing how Alaska's wealth is divided between minerals, fish, and furs.

contained in the Easy Reference Fact-Index at the end of this work

A MID-WINTER BANQUET OF THE REINDEER



This doesn't look much like a dinner party, does it? Yet it is, in a way; for you see here one of the immense reindeer herds in Alaska eating the lichens and mosses, which are the only food to be found on the ground during the long hard winter. Where the ground is covered with snow, the reindeer scratch their way down to this food with their hoofs. Cattle, of course, have to be fed in the winter, but the reindeer can take care of themselves on this winter pasturage. The reindeer combines the services of the horse and the cow, and can be kept where the raising of cattle would be impracticable. There are several thousand deer in this herd. You can see the horizon is thick with them, and there are more over the hill.

and during the summer the warm sunshine falls continuously on ground that is frozen to within a foot or two of the surface. Grasses grow luxuriantly in the river bottoms and wild flowers abound. Even in the crevices of glaciers plants are found, and it is no wonder that the early Russian explorers were not believed when they told such tales.

The area of Alaska, 590,000 square miles, is considerably larger than the 13 original states of the Union, and makes about one-sixth of the present United States. It is about equal in size to the 20 states which extend from the Gulf of Mexico to the St. Lawrence River, and from the Atlantic Ocean to the Mississippi.

The Aleutian Islands, a group of more than 150 islands strewn like stepping stones across the North Pacific from Alaska almost to the coast of Asia, are administered as a part of Alaska. Unimak Island, 65 miles long and 25 miles wide, is the largest. The native population of about 2,000

is supported by fishing, basket-making, and fox-raising.

The greatest mountain ranges, the highest peaks, and the most stupendous glaciers border on the Gulf of Alaska. Back of these chains lie great plateaus and tundras—swampy moss- and shrub-covered areas—through which flow the Yukon, 1,500 miles from the Canadian border to the Bering Sea, and other splendid rivers. It was in the Yukon Territory that gold was first discovered, and to reach the rich placer fields the early prospectors had to make their way over difficult and dangerous mountain passes, enduring cold and hardship almost beyond belief. Chilkoot Pass will always be

THE SHETLAND PONY OF THE ARCTICS



The genial "husky" between the shafts in this picture is probably an old dog who has been retired from the harder service of hauling freight, and devotes his time to amusing the children.

remembered as one of the most famous of these routes to the gold fields.

North of the plateaus and tundras is still another mountain range, the Endicott, which is considerably lower; and bordering on the Arctic Ocean is a sandy

THE GOOD OLD SUMMER-TIME IN ALASKA



You hardly think of juicy cantelopes and cabbages in connection with Alaska, do you? But remember that while the summer is short, the days are long. The sun shines from fourteen to sixteen hours each day and 75 degrees temperature is not uncommon.

For any subject not found in its alphabetical place see information

WHERE YOUNG ALASKA GOES TO SCHOOL



This is one of the modest schoolhouses in Alaska that are doing so much for those little dark-faced brothers and sisters of ours, whom you see standing in front of the door.

A THRIVING ALASKA TOWN

Here we are looking down the main street of Cordova, a thriving Alaska town, the location of which is shown on the map on a previous page. The place looks trim and clean and wide awake; full of the pioneer and progressive spirit which characterizes this great, new, rich undeveloped section of Uncle Sam's broad lands. Besides the land telegraph, as indicated by the poles, Cordova has a wireless station.



barren plain. Sitka is the center of that narrow strip of coast which, bordering on British Columbia, lies nearest "the States," and this city is the destination of most of the tourists. Along the greater part of the Gulf of Alaska the coast is broken by deep ravines like the Norwegian fiords, while back of these rise glacier-covered mountains in precipitous heights. The glaciers themselves cover a surface greater than all Switzerland.

The ascent of Mt. McKinley, 20,464 feet, in the Alaskan Range is probably the most difficult mountain-climbing feat in America; but Mt. St. Elias and Mt. Logan (the latter just across the border in Yukon Territory) are nearly as high, and there are scores of peaks whose summits reach up two miles or more. Live volcanoes still exist in the Alaska and Aleutian ranges, and through recent eruptions one of

them, Mt. Katmai, has been converted into the largest active crater in the world, a distinction hitherto held by Kilauea in the Hawaiian Islands.

Just as Norway, lying partly within the Arctic circle, is preserved by warm currents of the Atlantic from cold too great for human existence, so the shores and much of the interior of Alaska are warmed and made habitable by the Japanese current. Sitka boasts that in January it is often as warm as Los Angeles; but on the other hand the average temperature in the Yukon basin, from December to March, is 20 degrees below zero. Still farther north the thermometer sometimes goes to 70 degrees below. In the summer, in the same locality, it may be 90 degrees above—that is, as hot as it usually gets in the temperate zone of "the States." Yet Denver and other places in the States are frequently as cold as ice-bound dog-sledding Nome.

What Uncle Sam Has Done for the Natives

The contact of the white race with inferior races

of new lands has very frequently proved fatal to the native inhabitants. In Alaska the United States has demonstrated that it can rescue an inferior race from extinction. The United States Bureau of Education has checked the spread of white vices, and by education and the introduction of the reindeer it has given



UNITED STATES CUSTOM HOUSE AT EAGLE
A mining camp on the Yukon, near the Canadian border.

WASHING OUT THE GOLD, BUT SPOILING THE SOIL



This picture shows a typical Alaska landscape in which hydraulic mining is employed. Notice the great heap of soil spread out at the foot of the cliff and itself spreading out over the surrounding country, thus covering up a great deal of valuable soil with sand and gravel and making it unfit for use. In hydraulic mining a powerful stream of water is directed against a bank containing gold-bearing gravel. The gravel passes through a series of sluice boxes, in which the gold, being heavier, sinks to the bottom, while the gravel is carried on to be poured out on a pile of "tailings" like that at the foot of the bluff. Owing to the injury done to the soil this method of mining, which at one time did a great deal of damage in the Sacramento valley in California, has in that state been prohibited by law. In Alaska, where there is so much land and so few inhabitants, the wastefulness of the method is disregarded.

the natives new means of livelihood. From the reindeer the Eskimos and other natives (principally Thlingits and Aleuts) get meat, milk, and hides; it also furnishes them with means of transportation, and the possession of a herd encourages thrift and

industry. There were no reindeer in Alaska before the United States took possession, and the entire reindeer industry has grown up around the original herd of hardly more than 1,000 imported from Siberia. Now there are 100 times that number, and

THE HARBOR OF UNALASKA



This is the harbor of Unalaska, which is situated on the island of Unalaska, one of the Aleutian group. It is a port of call for ships going in and out of Bering Sea. The island is 135 miles from the end of the Alaskan peninsula. Unalaska is only a village, and its population is chiefly engaged in sealing and fishing. The island is very mountainous. It also has on it a volcano; indeed, all the islands of the Aleutian group are of volcanic origin.

For any subject not found in its alphabetical place see information

the income of the natives from the reindeer in a single year amounts to as much as \$100,000.

Alaskan history has four important dates: 1741, 1867, 1898, and 1914. The first marks the arrival of the Russians, who came for the furs of the otter and the seal. They looked for gold and silver, but by a fortunate chance these discoveries were left for Americans. Under the iron rule of the Russians, the Aleuts, a gentle race of Indians living in the southern islands, were reduced in numbers from 25,000 to barely 1,000, and this may be taken as typical of their severity and exploitation. In 1867 the Russians thought they could see the beginning of the end of the

bility of developing a great food supply aside from the fisheries, Alaska's destiny is assured.

Alaska has a territorial form of government with its own legislature and makes its own local laws; but the governor is appointed by the president of the United States. Its one delegate in Congress has a right to speak, but no vote.

ALBANIA (*āl-bā'nī-ā*). The mountainous country of Albania, little larger than the state of Vermont, has been well called the "stepchild of Europe," for it has been a bone of contention among the neighboring nations ever since the fall of the Roman Empire.

The country, situated in the western Balkans, on the eastern coast of the Adriatic, is a Balkans in miniature, for within its borders it shows all the geographical differences of mountain and valley, of racial and religious animosity, which characterize the Balkans as a whole, the storm center of Europe. Despite their fierce love of independence, the Albanians have never achieved national unity. Tribe is perpetually at war with tribe, and the code of the feud is the supreme law. Two-thirds of the population of about 850,000 are Mohammedans, and the rest are Christians of the Roman Catholic and Greek Orthodox churches (see map under Balkan Peninsula).

The history of this little country dates back to before the days of the Roman Empire, for the Albanians are descendants of the oldest race in Europe, the ancient Illyrians and Epirotes, with an intermixture of Slavic and Turkish blood brought in by wave upon wave of barbarian invasions. Their great national hero is George Scanderbeg (1403-1467), who maintained a guerilla warfare against the Turkish invaders for nearly 25 years. His name is a corruption of the title Iskender Bey (Prince Alexander) bestowed on him by the Turks. Handed over in his youth as a hostage to the Mohammedans, he was promoted to high military command; but when opportunity came he revolted and gathered the Albanian clansmen around him in their mountain fastnesses. But the unity he created perished with him, and soon after his death Albania fell under Turkish dominion.

Again and again the liberty-loving clansmen rose against their oppressors; but the Turkish yoke was not finally shaken off until 1912, when Albania was recognized as an independent state. A few months later a German prince, William of Wied, was made ruler, but was forced by his subjects to flee at the outbreak of the World War of 1914-18, and war and anarchy followed. In 1917 the independence of

WHERE ASIA AND ALASKA MEET



Ages ago North America and Asia are supposed to have been one continuous land across what is now Bering Strait and Bering Sea. You remember from your geography lessons what a sunken coast looks like, don't you? And you can see the marks of such a coast in the irregular outline in deep indentations of these two coasts. As the land sank and the sea came in to separate the two continents, these ragged shores were formed. The northern limit of the icebergs and of the cereals is determined by the warm Japan current. Notice also the international date line, where today is yesterday on one side of the line, and yesterday is today.

country's resources, and so they sold the land to the United States.

In 1898 the rush of the "forty-niners" to California was repeated in Alaska, when the Klondike (though this is in Canada) became the goal of seekers for quick and easy wealth. Nome, Fairbanks, and other places were soon on everybody's tongue. In 1903 the Alaskan Boundary Commission settled a troublesome dispute between Great Britain and the United States in regard to the boundary line separating Alaska and Canada.

An event that should be set down as marking a new era in Alaskan affairs was the beginning of work on the government railroad from Seward to Fairbanks, in 1914. This 471-mile project, carried through with the indomitable energy which marked the activities of Alaska's early settlers, brings Alaska definitely into that world of industry for which it is so splendidly endowed.

Alaska is an empire in the making; but its making is slow, partly because of the difficulty of building and maintaining railroads, and partly because of the difficulty of getting labor in that cold region. For the most part it is still a country of the stagecoach and the dog-sled, though it no longer has the wilderness aspect of the frontier. The population for a time actually declined. In 1910 there were 40,000 whites, but in 1920 it was estimated that there were less than 30,000. The natives have advanced slowly in numbers in recent years, and there are probably about 26,000 of them.

Norway with fewer resources and a climate of no greater moderation has a population of 2,400,000—a population that is supported on an area only about one-fourth that of Alaska's. But with great stores of minerals, with plenty of coal for heat and smelting processes, and with the possi-

Albania was again proclaimed and a provisional government was set up at Durazzo.

ALBANY, N. Y. As the capital of the most populous state in the Union, and as the second oldest settlement in the original 13 colonies, the old Dutch city of Albany would be an interesting and important place, even without the flourishing commerce and industry which have made it conspicuous for nearly three centuries. The city is picturesquely located on the right bank of the Hudson River, 145 miles north of New York City. If you ascend the Hudson on one of the large steamers for which Albany is the head of navigation, you will be impressed by the beautiful new waterfront—about three miles of piers and warehouses of brick and concrete. As you go back from the river the land soon begins to rise in a long vigorous slope, and at the top of the great hill, where was the fort of the colonial town, is now the great marble state capitol.

The capitol building presides not only over the city but over the entire neighboring valley. Its size, its situation, and the dignity of its architecture combine to make it impressive. Built of white Maine granite, it is 300 feet wide, 400 feet long, and covers more than three acres. The building was begun in 1871 and by the time it was completed in 1904 the cost had mounted to \$25,000,000. The great western staircase—said to be the finest staircase in the world—alone cost \$2,000,000. This is only one of the fine

population increased by leaps and bounds, but when through rail routes were established to the west its importance as a freight center began to decline. It is still, however, an important transfer point for passenger, express, and mail traffic.

Beautiful examples of Dutch and colonial architecture in the residence section testify to Albany's long history. In 1614 some Dutch traders settled on the island just below the present location. Ten years later they moved across the river and built Fort Orange. The settlement was on the grant of land given to Killian Van Rensselaer by the Dutch government, and the place was named "Beverwyck"; but when it came into the hands of the British, in 1664, it was christened "Albany" for the Duke of York and Albany, who later became King James II.

In 1754 the famous Albany Congress met here to establish more friendly relations with the Indians and to draw up a plan of union of the colonies. A plan, largely the work of Benjamin Franklin, was outlined, but it was rejected by the colonists because they felt that it gave too much power to the king, and it was rejected by the king because he declared that it left too much in the hands of the colonists.

During the Revolutionary War Albany was a strategic point, and against it was directed Burgoyne's expedition which ended in his surrender at Saratoga. In 1797 the town became the permanent capital of the state. Population, about 115,000.

ALBATROSS. The great wandering albatross of the lonely southern seas holds a strange spell over the sailor. He believes this bird, following a ship for

HOW THE ALBATROSS "TAXIES" TO GET A START



Looks as if he were running on top of the water, doesn't it? That's exactly what he is doing. The albatross doesn't raise himself by jumping into the air and vibrating his wings, as you see little birds do on land. He spreads his wings out stiff, like the planes of a flying machine, and runs along the water until these planes of his lift him up, as the flying machine is lifted by its planes and as your kite is lifted up when you run with it. This running along the surface when rising, the airmen call "taxi-ing."

buildings which, combined with large public parks and wide boulevards, make Albany a beautiful city.

From the days of the Indians, when the great Mohawk trail met here other important trails and canoe routes to the southwest, north, and east, Albany has been a great trading center. With the completion of the Erie Canal in 1825 (*see Canals*) its

days at a time with seemingly motionless wings, possesses an unnatural power, and no sailor is so bold as to harm one of them. About this old superstition Coleridge constructed his well-known poem, 'The Ancient Mariner'.

The wandering albatross (*Diomedea exulans*) is the largest of all water birds, and it has the greatest wing

expanse of the entire bird kingdom, its wings often measuring 10 to 14 feet from tip to tip. Its body, however, weighs only about 18 pounds. The feathers covering the body are white with wavy black lines, and they are very thick. The wing feathers are dark and, at the tips, quite black. The male and female birds dress exactly alike.

The three front toes of their large feet are webbed, and the hind toe is small.

The albatross lives on the wing. It lights on the water only to snatch a fish or a bit of refuse from a ship. When it wishes to rise again it lifts its great wings and runs along the top of the water for 70 or 80 yards before it can acquire sufficient impetus to do so.

During the nesting season these birds go to the barren antarctic islands, where the mother bird lays her egg, a large whitish one with brown spots, which she usually deposits on the bare sand. When the baby bird is hatched, it is tended by the parent birds until it is able to care for itself.

There are about 16 species of albatrosses and all like best to live in the tropic seas. The black-footed and Laysan species, however, wander as far north as Alaska and are often seen off the Pacific coast.

ALBERT I, KING OF THE BELGIANS (1875-). A dull leaden sky stretches over a ghostly gray land of flood and mist. In the distance a thin grayish-brown shadow among the mutilated tree trunks marks the German lines of that section of the battle-front in the westernmost corner of Belgium. Near at hand are mounds of earth and sandbags rising breast high from the mud and water, the sole protection of the little Belgian army. On a duck-board walk behind one of these embankments we catch a glimpse of a group of soldiers in their mud-caked uniforms. One, taller than the rest by several inches, walks with a slight limp, the result of a wound received early in the war.

Suddenly the scene shifts and we find ourselves in Brussels on Nov. 22, 1918. The streets of the capital are filled with throngs of joyous and excited Belgians. Suddenly there arises the shout, "The King is coming," and we see down the flower-strewn street lined with waving flags a procession, the most conspicuous figure in which is the tall soldier of the firing-line.

It is King Albert, the hero-king of the Belgians, who for four long years was practically a king without a country, but who now has come into his own at

a time when the kings and kaisers of the Central Powers are scurrying like frightened rabbits to safe hiding-places. And if we go forward a few years and visit some of the firesides of Belgium, we shall hear the men who fought in the World War of 1914-18 telling their children and grandchildren of how they

saw their king in a soiled uniform, eating the warmed-up soup of the regular rations, sharing his match with a soldier from whom he has just received a cigarette, or helping to render first aid to those injured in battle.

Is it any wonder that the people of Belgium are devoted to their king? As one Socialist said, after three months of war, "If Belgium

were made a republic and the people had an absolutely free choice for president, they would elect King Albert by a vast majority."

When Prince Albert first learned that he was to succeed his uncle Leopold II as king of the Belgians, he decided that he needed more knowledge for his future task. Like Peter the Great of old, he thought he could obtain this more readily if people did not know who he was. So, disguised as a newspaper reporter, he went to the principal seaports of Europe to study shipping and shipbuilding. Later—in 1898—he came to the United States to investigate the railroads; and he went to South Africa to observe at first hand conditions in Belgium's colony, the Congo State.

When he became king in 1909, at the age of 32, he began to apply the knowledge he had gained. He improved the merchant marine of the country, and he brought about better conditions in the Congo. But most of all he wanted to reorganize the army. After a long struggle with parliament he secured its consent, but the work was only half completed when on that fateful Aug. 2, 1914, Germany demanded a passage through Belgium in order to attack France. This King Albert refused, and war followed. Albert at once hurried from Brussels to join his army, and he never left it except when it was necessary for him to cross into France or England to confer with heads of the other armies.

And not far from him in all those four long years, working in the hospitals just back of the lines, was his wife, Queen Elizabeth, earing for the wounded and feeding the hungry. While Albert was in the trenches she was in the hospitals except for brief airplane trips to England to visit her children who had been sent there for safety. On a brief visit to the United States after the terrible war was at last over, King Albert and his Queen were given a most enthusiastic welcome.



ALBERT I, KING OF THE BELGIANS, AND HIS CONSORT



BEAUTIFUL ALBERTA, LAND of GOLDEN GRAIN



ALBERTA,
CANADA. The foothills of the Rockies and the prairies of western Canada meet in the rich province of Alberta, the most westerly of the three Prairie Provinces. This vast new region, of nearly 256,000 square miles—more than twice the size of Great Britain and Ireland—extends 750 miles north from the boundary line with the United States, and is from 250 to 400 miles wide. Its average elevation is considerably higher than that of its eastern neighbor Saskatchewan, and its surface is more diversified. About half of its total area, or more than 80,000,000 acres, it is estimated, can be profitably used for farming. A large part of this agricultural land is still public domain, and homesteads of 160 acres are obtainable on easy terms from the Dominion government.

Besides its wealth in fertile farming land, Alberta also contains extensive deposits of coal and other minerals. More than 56,000 square miles, it is believed, are underlain with valuable coal, giving Alberta 85 per cent of the coal of the entire Dominion. Natural gas is found in large supplies, chiefly in the Medicine Hat district, which is rapidly becoming an important manufacturing center because of the advan-

Extent.—North and south, 750 miles; east and west, 250 to 400 miles. Area, about 256,000 square miles. Population, about 600,000.

Physical Features.—Rocky Mountains on southwestern boundary; South Saskatchewan, Red Deer, North Saskatchewan, Athabaska, Peace, and Hay rivers; Lesser Slave Lake, Lake Claire, and Lake Athabaska.

Products.—Wheat, oats, barley, rye, flax, hay, turnips; cattle, sheep, horses; coal, asphalt, and petroleum; timber.

Cities.—Calgary, Edmonton (capital), Lethbridge, Medicine Hat.

tages afforded by this cheap fuel. Traces of petroleum are found over practically the whole province, and immense beds of bitu-

minous or "tar" sands, which are estimated to yield one barrel of crude oil to the cubic yard, extend for a hundred miles along the Athabaska River.

There are three natural divisions of the province. Southern Alberta is open prairie, except for the foothill country. This region was at one time given over to ranching but it is now chiefly devoted to grain farming. Here the winters are tempered by the warm dry chinook winds (*see Winds*), which frequently melt the winter snows and raise the temperature from below zero to springlike warmth within a few hours, making it possible for cattle and horses to graze in the fields all winter. This advantage is partially counterbalanced by the fact that these warm winds carry off the moisture, making it necessary in some parts to practice irrigation and dry farming.

Central Alberta, the country lying north of Calgary, with Edmonton (the capital) as its center, is

the most thickly settled part of the province. In the north it has a considerable tree growth, principally of poplar and other soft-wood trees. The effective precipitation is greater, and the moisture-holding qualities of the rich black soil better than in southern Alberta. Central Alberta is the great mixed farm-

FARM LIFE IN CENTRAL ALBERTA



These pictures will give you a good idea of what it is like to be a farmer in central Alberta. What level fields of rich black soil! Those hogs are of the best breed and you see they are being treated as all well-bred hogs should be. And so they are giving the farmer ample returns on his investment. In the next picture are samples of sugar corn and tomatoes grown in Alberta. The lower right hand picture shows a fine stand of fodder corn on a dairy farm, the same farm on which the pigs are enjoying themselves. With such opportunities for profitable farming, it is not to be wondered at that the population of Alberta has grown so rapidly and that no schools in the world are more popular with boys and girls than the excellent agricultural schools in this province.

ing, dairying, and pure-bred stock-raising part of the province. It produces heavy crops of feed grains, hay, and roots.

Northern Alberta, so far as development is concerned, is the Peace River valley. This part of the province, which still has considerable areas of free public land, is attracting settlement to a greater extent than any other part of Canada (see Peace River). The timber resources of Northern Alberta are large, for a forest belt extends hundreds of miles on the north side of the Saskatchewan River. The foothill country abounds in game of all sorts—Rocky Mountain sheep, goats, elk, moose, caribou, and a great variety of useful game birds such as grouse, partridge, geese, and ducks. Fur-bearing animals such as the bear, beaver, marten, otter, muskrat, and prairie timber wolf furnish an output valued at between \$2,000,000 and \$3,000,000 annually passing through Edmonton. The lakes and rivers abound with fish. There are several park reservations in Alberta, the most notable being the scenically beautiful Rocky Mountain Park, with Banff on the Canadian Pacific Railway (82 miles west of Calgary) as the most interesting point; and Buffalo

Park, at Wainwright, where 4,000 buffalo and a number of elk are preserved on a reservation of more than 100,000 acres.

Since its organization as a province in 1905, Alberta has had a government similar to that of the other provinces of the Dominion. Good provision has been made for education by a system of public, secondary, and college institutions. There are technical schools in the cities and a system of secondary agricultural schools in small towns for farm boys and girls. The growth of the province has been phenomenal, the present population of about 600,000 being nine times the population at the beginning of the century. (See Calgary; Edmonton.)

ALBU'MEN. This substance, so important in plant and animal life, is best known in the form in which it appears in the white of eggs, which consists chiefly of albumen and water. In this form albumen is a transparent semi-fluid substance, but if heated it coagulates and hardens, as we find it in a hard-boiled egg.

Albumen is found in the serum of the blood, in the vitreous and crystalline humors of the eye, and in the juice of animal flesh. Another variety occurs in seeds,



grains, and in the juices of plants. Albumen belongs to the class of substances called proteins, which form an important part of food, since they build up the tissues of the body (see Proteins).

When albumen coagulates in a fluid, it encloses any substance that may be suspended in the fluid and with this impurity rises to the surface as scum, or sinks to the bottom, according to the weight of the liquid holding it. Thus the white of egg is used to "settle" coffee, and other forms of albumen are used to clarify sugar, etc.

In modern chemical usage the word *albumen* is usually applied only to the white of egg and to the nutritive substance found in seeds. The related forms are called albumins. The chemistry of the albumins is exceedingly complicated, but all contain carbon, hydrogen, nitrogen, sulphur, and oxygen.

ALCOHOL. The word alcohol is of Arabic origin and was originally applied as the name of a kind of black paint used by Eastern women for darkening their eyebrows. It is not known how the word came to be applied in its present use.

Alcohol is produced by the action of yeast on sugar. There are several varieties of yeast and several kinds of sugar (*see* Sugar). Fruit juices, such as those of grapes, apples, berries, etc., are frequently used as the source of the sugar. The yeast is then put in and fermentation follows, producing alcohol and carbon dioxide. The latter, being a gas, escapes into the air and is the cause of the bubbling which we see in fermenting liquids. Grains are another source from which alcohol is produced. Corn, rye, barley, etc., are "malted"—that is they are allowed to sprout, the starch of the grain thus being converted into a sugar (*see* Enzymes). Water is then added to make a "mash," and fermentation is started. Ground potatoes or ground grain with the addition of molasses may be used instead of malted grain. The alcohol is then separated by distilling the fermented "mash"; this is usually done by boiling the mixture in a covered vessel and condensing the vapor by passing it through a coiled copper tube or "still" immersed in cold water.

Alcohol is the active principle of intoxicating drinks. Brandy, whiskey, rum, and gin are distilled liquors, and contain about one-half alcohol. The fermented juices of fruits if used undistilled are called wines or cider, and contain about 7 to 14 per cent of alcohol. Beer and ale are fermented from malted barley with the addition of hops; they contain from 2 to 10 per cent alcohol. When alcohol is drunk it undergoes oxidation in the body, just as sugar, starch, and other similar substances do. It produces at first exhilaration; then, as it gets possession of the nerves of feeling, stupidity; then, when it has paralyzed the nerves of motion, insensibility; and finally, if taken in large quantities, it reaches the heart and the result is death. By the 18th amendment to the Constitution, the importation, manufacture, and sale of alcoholic beverages in the United States is prohibited (*see* Prohibition).

Alcohol has many interesting properties, however, making it of great industrial importance. As it never freezes at any natural temperatures, it is used in cold countries in thermometers. It is used in medicines for dissolving drugs, in varnishes for dissolving the resins and gums, and in cologne for dissolving the oils and other aromatic substances. It is used for preserving zoölogical specimens, and as an antiseptic in treating wounds. Chemists and others find it a clean and valuable fuel; and with the growing scarcity of gasoline, efforts are being made to develop the use of alcohol in this country, as it already has been abroad, as fuel for automobile and other internal combustion engines.

Ordinary alcohol, which is sometimes called "grain alcohol" or "spirits of wine," is known to the chemist

as "ethyl alcohol." Its formula is C_2H_5OH . When deprived entirely of any admixture of water, it is called "absolute alcohol," and has important uses in the sciences and arts.

The chemical name for wood alcohol, CH_3OH , is "methyl alcohol." It is made by the dry distillation of wood, especially beech, maple, or birch. In many uses it can be substituted with success for grain alcohol, and it is much cheaper than the latter. But it is strongly poisonous and must not be used internally, total blindness, if not death, being the result of drinking it. Because it is not adapted for use as a beverage, its manufacture and sale are freely permitted. The same is true of "denatured alcohol," which is ethyl alcohol with an admixture of 10 per cent or more of methyl alcohol or other substance which unfits the mixture for drinking, while allowing of its use for industrial purposes. The most important uses of denatured alcohol are as a fuel and in the manufacture of aniline dyes, starch, soaps, tobacco, shellac, celluloid, paints, shoeblacking, disinfectants, explosives, anti-freezing mixtures, and cleaning and polishing preparations.

Solidified alcohol or "canned heat," so much used for alcohol stoves, is made by mixing denatured alcohol with melted stearic acid, adding a little phenolphthalein solution and a few drops of strong sodium hydroxide in solution, which gives the faint pink color. When hardened it can be cut in cubes.

ALCOTT, LOUISA MAY (1832-1888). In a quaint "homey," many-windowed, rambling brown house set in an old-fashioned garden near Concord, Mass., there lived about 75 years ago a family well known to all readers of 'Little Women'. The four girls who, under the names of Meg, Jo, Beth, and Amy, became like sisters to all the young girls of America, there worked, studied, played, and grew to young womanhood.

The father—Amos Bronson Alcott, whose name is associated with those of Emerson and Thoreau in the literary life of Concord—was a noble-hearted man and a very earnest philosopher and teacher, but too impractical to earn a comfortable living for his family. So the burden fell on Mrs. Alcott, the capable, sweet-natured, and unselfish "Marmee" of 'Little Women', until Louisa (the Jo of the story) through her teaching and writing lifted the burden from her mother's shoulders.

Louisa Alcott had begun to write verses at the age of 8, and at 16 she sold her first story. But there



This is "Jo"

were many trials and hardships before her writing brought her much money or recognition. Her first successful book was 'Hospital Sketches', published after illness forced her to give up her work as an army nurse in the Civil War. 'Little Women', written soon afterwards, won the hearts of young and old, and made its author famous. Her readers clamored for more, and in spite of ill health and many responsibilities, she continued until the end of her life to write one after another of her cheerful, wholesome, warmly human novels.

Louisa Alcott's best-known works are in 'The Little Women Series,' with titles as follows: 'Little Women' (1868); 'An Old-Fashioned Girl' (1869); 'Little Men' (1871); 'Eight Cousins' (1874); 'Rose in Bloom' (1876); 'Under the Lilacs' (1878); 'Jack and Jill' (1880); 'Jo's Boys' (1886). Among her many other stories are those in the 'Aunt Jo's Scrap-Bag' Series, (1871-82), and the 'Spinning Wheel Stories' (1884).

ALDER (*al'dēr*). Almost every brook or stream of New England is shaded by the dark olive-green foliage of the speckled alder, and mile after mile of valley road is edged by this beautiful bushy tree. It is the brook-trout's best friend, for it shades his pebbly retreat and entangles the angler's fly. There are 20 species of alder, the most common species native to our country being this speckled or hoary alder, which is found in wet places from Pennsylvania and Nebraska north to Canada. It is more properly a shrub than a tree, yet it often grows to a height of 20 feet, and sometimes has one substantial trunk. The leaves are oval, coarse, and irregularly notched, with a whitish down underneath. The graceful purple and yellow catkin appears in the spring, scattering clouds of pollen if disturbed. In the autumn the catkin buds and cones, which resemble tiny red-pine cones, are found on the same bush. The wood is soft, light, and of little value. It will not endure alternate wetting and drying, but if kept under water becomes hard and durable; so it is sometimes used in mill-work, piles of bridges, watering troughs, etc. The branches furnish the best charcoal for making gunpowder.

The European alder (*Alnus glutinosa*), which often adorns our parks, is a handsome tree from 25 to 60 feet tall, with leaves very much like those of the speckled alder.

Scientific name of speckled alder, *Alnus incana*. Bark shiny, ruddy green. Branches bushy, crooked. Leaves alternate, oblong with pointed tips, finely notched; dark green turning yellow in autumn.

ALEXAN'DER, CZARS OF RUSSIA. Three of the autocratic rulers of "all the Russias" have borne the eminent name of Alexander.

ALEXANDER I, who ruled 1801-1825, was czar during the Napoleonic era and was connected with many of the stirring events of that time. Forced into hostilities by the ambitions of the French conqueror, in 1805 he joined with England, Austria, and Prussia in the great European coalition against France. But after the defeat of his army at Friedland, in 1807, he deserted the allies, and in the treaty of Tilsit he and Napoleon agreed to divide

the world between them. Alexander was to rule the East and Napoleon the West. Alexander soon discovered, however, that Napoleon's continental blockade (*see* Napoleon) was injuring his country, and other causes of dispute arose; so he returned to the cause of the allies. Napoleon's disastrous expedition against Russia in 1812 proved the beginning of the French emperor's downfall. In 1815, at the Congress of Vienna, Alexander still showed some of the liberal principles which he had earlier adopted. He was also somewhat of a religious mystic, and to him was due the formation of the Holy Alliance. In this the sovereigns declared their "fixed resolution to take for their sole guide the precepts of that Holy Religion (Christianity)," and to "remain united by the bonds of a true and indissoluble fraternity." The "Holy Alliance" really never amounted to anything but the name came to be applied to the Grand Alliance, which was the governing body of Europe at that time. Subsequently Metternich so worked upon Alexander's fears that he became as conservative as any of his brother rulers, and in his last years undid many reforms of the first part of his reign.

ALEXANDER II, 1855-1881, the grand-nephew of Alexander I, was popularly known as "the Czar Liberator" because on March 3, 1861, he issued the great Edict of Emancipation, giving to the serfs of Russia their freedom and a share in the lands which they had cultivated for generations. But like Alexander I he began to take fright at his own liberal work and became a reactionary. The disappointment felt by many at this change of attitude was great, and it led to several attempts by secret societies of "Nihilists" or terrorists to assassinate him. One of these was finally successful in March 1881, when a nitroglycerin bomb was hurled against his carriage. That very day the Czar had signed a "ukase" or decree which would have laid the foundation of constitutional government in Russia.

ALEXANDER III, 1881-1894, revoked his father's decree, and his whole reign was one long struggle between a rigid reactionary policy on the part of the court and the unsuccessful attempts of the terrorists to reform the government by plots and assassinations.

ALEXANDER THE GREAT, KING OF MACEDON (356-323 B.C.). "My father will leave nothing for me to do!" So the boy Alexander once exclaimed as he noted the triumphs of his father, Philip, king of Macedon. But though Philip made himself master over nearly all of the Greek states, the rest of the civilized world remained as a vast field for Alexander's conquests—a field not too great for his boundless ambition and his far-reaching genius as a soldier and statesman.

During the 13 years of his reign, 336-323 B.C., Alexander wrote his name large on the history of four civilizations—the Greek, Semitic, Egyptian, and Iranian—and made himself a place with the few men like Caesar, Charlemagne, and Napoleon, who have decisively changed the current of world history.

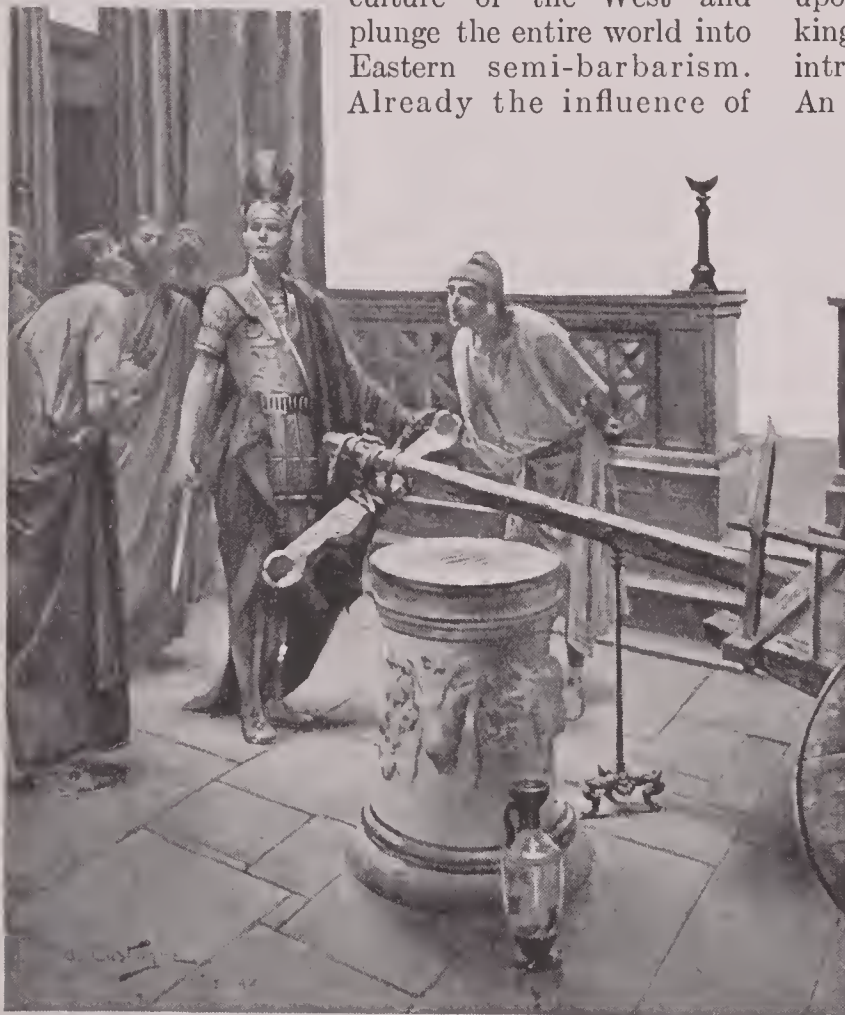
Born at Pella, the capital of Macedon, in 356 B.C., and carefully educated by the great Aristotle, he early gave evidence of his remarkable gifts. When only 16 he took charge of the government in his father's absence. Two years later he showed such courage in the battle of Chaeronea, where the Macedonians defeated the Greek forces, that his father, embracing him, said: "My son, ask for thyself another kingdom, for that which I leave is too small for thee."

At Philip's death, Alexander, not yet 20 years old, ascended the throne and prepared to finish the conquests which his father had begun. When Thebes revolted, he struck terror into all Greece by razing the city to the ground. His respect for Greek art and letters, however, led him to spare the house of the poet Pindar.

Conquest of the Mighty Persian Empire

With Greece at his feet, Alexander was now free to realize the almost incredibly bold design of conquering the Persian Empire—an empire fifty times as large as all Greece and with twenty times as many people. For centuries the life of Greek civilization had been menaced by Persia, which had pushed westward to the Aegean Sea. The danger was ever present of some sudden powerful stroke which should crush the

culture of the West and plunge the entire world into Eastern semi-barbarism. Already the influence of



ALEXANDER AND THE GORDIAN KNOT

Here we see the young conqueror just as he is about to deliver the sword stroke that cut the Gordian knot, thus, according to the oracle, revealing himself as the future master of the world. He is holding one end of the knotted thong with his left hand, while his right hand holds the sword ready to deliver the stroke.

Oriental life and superstition was sapping away the strength of Hellenism. Alexander's mission was first to free the Greek cities of Asia Minor—one-third of the entire Greek world; then to sweep Persian power from the rest of the eastern Mediterranean; and finally to crush Persia itself so thoroughly that centuries were to elapse before the East should ever again seriously menace the West. By extending Greek civilization over all the shores of the Mediterranean and into interior Asia, Alexander unwittingly paved the way for the spread of Christianity three centuries later.

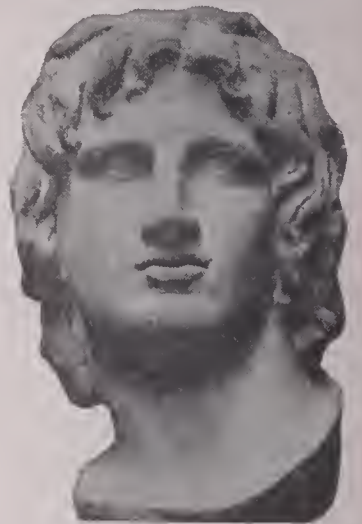
Crossing the Hellespont, Alexander invaded Asia Minor in 334 and defeated the Persians in a number of battles, overthrowing with his own lance the son-in-law of the king. The cities of Asia opened their gates to the conqueror as he marched

to meet the great king himself. On the way he came upon the famous Gordian knot, with which a Phrygian king had bound his chariot yoke so tightly and so intricately that no one had been able to untie it. An oracle foretold that whoever should untie that knot should become master of the world. Alexander "cut the Gordian knot" with a single stroke of his sword. That was always his way with difficulties; he solved them—just as he won his victories—by sudden bold strokes, rather than by subtle and ingenious methods.

Alexander met the Persian king Darius III in the great battle of Issus, between the mountains and the sea at the northeastern corner of the Mediterranean. Here the resistless Macedonian phalanx utterly routed the disorderly masses of the Persians (333 B.C.). The Persian monarch offered all Asia, as far as the Euphrates, as the condition of peace; but his conqueror proudly refused.

Onward he swept, reducing the enemy's strongholds one after another. Egypt easily fell into his hands, and there he built one of the 70 cities he is said to have founded—the city of Alexandria, destined to be in a few decades the metropolis of Egypt.

With the Mediterranean world in his grasp, Alexander now retraced his steps eastward and thrust at the heart of Persia itself. He met Darius again in the spring of 331 at the battle of Arbela, near the Tigris River. The Persians greatly outnumbered the Macedonians, but their army was easily crushed. Darius, utterly vanquished and forced to flee, was stabbed by his own treacherous attendants.



ALEXANDER THE GREAT, FROM A BUST IN THE BRITISH MUSEUM

Alexander entered in triumph Babylon and Susa, the storehouse of the treasures of the East, and Persepolis, the capital of Persia. Continuing eastward and northward he conquered the Scythians on the banks of the Jaxartes River. He then turned southward, planning to conquer India. But when he had reached the valley of the Ganges, his soldiers, wearied with nearly eight years of fighting, refused to follow him further, and he was forced to turn back.

End of a Great Career

Returning to Babylon, he found ambassadors from all parts of the world awaiting to pay him homage. Not satisfied with this homage, and perhaps moved by the fact that the eastern peoples he had conquered would not permanently acknowledge the sway of any except a king who claimed divine descent, Alexander had for some years demanded that his subjects worship him as a god. So unbounded had his pride and arrogance become that in a burst of passion he had killed his best friend Clitus who mocked at his pretensions to divinity. Like many another conqueror, Alexander was himself partly conquered by the life and ideals of the people he had overcome.

It was Alexander's settled policy to rule Asia in Asiatic fashion, and to graft Greek culture upon Persian civilization so far as he could. He married two Persian princesses, and had many of his followers take Asiatic wives. He wore the Persian costume and adopted the ceremonies of the Persian court, to the indignation of his sturdy Macedonian followers. He kept the ancient Persian system of government for the most part; but he put three officials of equal rank at the head of each province, instead of the one all-powerful satrap

overflow of the river, one of the earliest scientific expeditions of which we have record.

But with the greatness of Alexander's character there were mingled elements of weakness. He gave way at times to dissipation, and it was perhaps as a result of a drunken debauch that he contracted a fever and died in 323, at the age of 33.

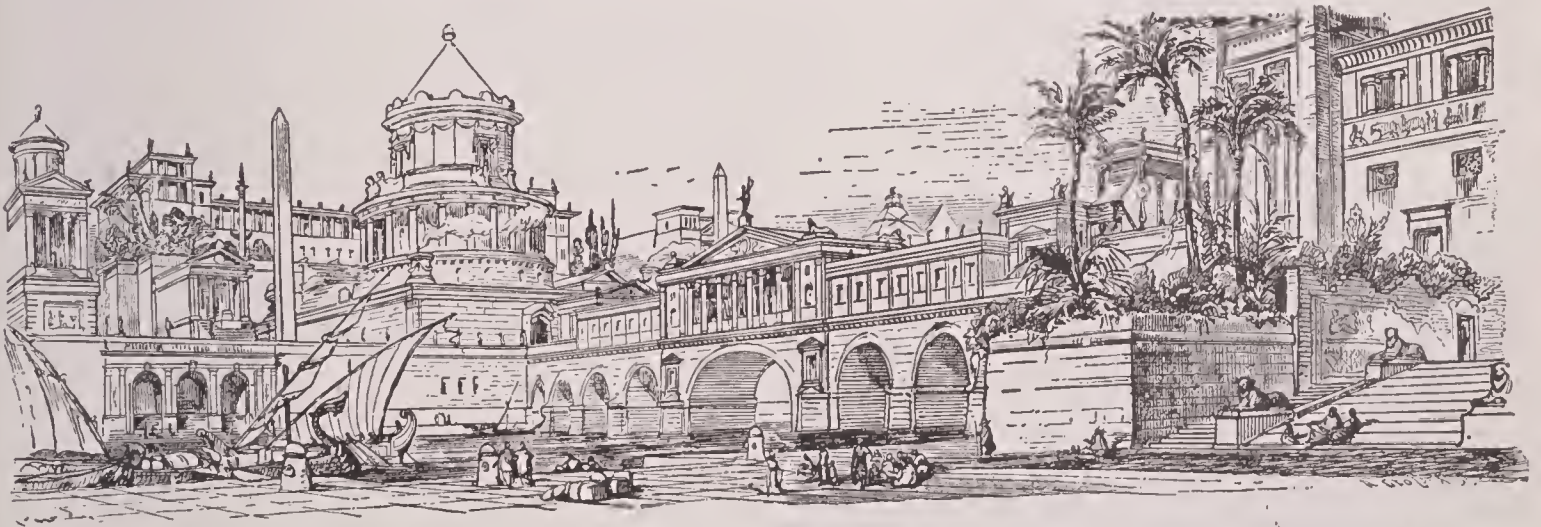
ALEXANDRIA, EGYPT. Of all the cities which Alexander the Great scattered over the East, Alexandria, near the mouth of the Nile, is the most famous. At the height of its splendor it even rivaled "the glory that was Greece and the grandeur that was Rome."

Let us picture Alexandria in the early centuries of the Christian era. Over the blue waters of the harbor glided Roman war galleys, with dazzling sails and flashing oars. At the docks were moored big grain ships loading for Rome, their tall sides rising story on story above the buildings along the shore. Nearby were ships that had braved the Atlantic storms along the coast of Spain, and oriental craft which had passed through the Nile canal from the Red Sea and Indian Ocean, bringing rich goods of the East.

Picturesque Metropolis of the Mediterranean

On the noisy quays gathered a motley crowd—Jews, Greeks, Romans, Egyptians, and negro slaves from Nubia—mingling all dialects and all manner of costumes. Sailors and soldiers told tales of distant lands, while merchants and dock hands hurried about among the huge piles of merchandise. Heaps of native wheat, bars of tin from the British Isles, bolts

ALEXANDRIA IN THE DAYS OF ITS GLORY



Here is Alexandria in the days of its glory. The picture shows the Greek quarter—as you can see from the style of much of the architecture. But you can also see the Roman arch and the Egyptian type of building with its sphinxes on the staircase. The royal palaces flanked the harbor on the east. In front of the great theater was the temple of the sea god Neptune. In Alexandria stood the two great obelisks which you see in the picture, known as "Cleopatra's Needles." One of these is now in New York, and the other in London.

of the Persian system, thus affording better protection both to the central government and to the people.

Alexander vigorously promoted enterprises for the benefit of his subjects and in the interest of scientific research. He erected many great public buildings, ordered the restoration of the canal system of Babylonia, and set on foot many other public works. He never ceased to take a deep interest in learning. Even on his great campaigns he collected hundreds of natural history specimens and sent them to his old teacher Aristotle, in Athens. He sent an exploring expedition up the Nile to ascertain the causes of the annual

of silk from China, and cotton fabrics from India cluttered the wharfs. And above the whole picturesque scene towered the gigantic Pharos—the first of lighthouses and one of the seven wonders of the world.

Within the city, and ringing a wide semicircle of blue sea, were great palaces and towers surrounded by beautiful parks and gardens adorned with tropical trees, lakes, fountains, and sculptured monuments. And here, in the midst of this natural beauty,

gathered the most celebrated intellects of the world. For Alexandria had become not only the greatest commercial center of the Mediterranean, but also the seat of ancient art, philosophy, and religion.

In Alexandria flourished the famous Hellenistic or later Greek civilization. Its famous museum contained a library of over 400,000 manuscripts, and was founded by the first Ptolemy, when he became king of Egypt at Alexander's death, near the close of the 4th century B.C. Among those priceless documents generations of writers, scientists, and philosophers, including Euclid the father of geometry, Theocritus the Greek poet, and more recently Ptolemy the geographer, had held grave discussions. And since the dawn of Christianity, the problems of the new religion were fought out in bitter controversies, culminating in the great split between Athanasius, the bishop of Alexandria, and the priest Arius, founder of the famous Arian heresy.

Alexandria under Christian Rule

The old temples, where once the pagan gods held sway, were thronged with dark-clad monks at their devotions. Through the green gardens and airy colonnades wandered bronzed and ragged hermits from the desert—men whose fierce religious zeal showed in their wild eyes, their limbs wasted with long fasts, and torn with self-

A BEGGAR BY THE WAYSIDE



The beggar by the wayside is a common object in Egypt, as in other parts of the Orient. This picture shows one of these men who lives entirely on the charity of the passer-by. He is sitting near the wall of one of the native cemeteries.

inflicted wounds. They had left their cells and huts in the wilderness to preach of the approaching end of the world, and on every corner they stopped to denounce with burning words the sinful luxury of the great city.

THE FAMOUS POMPEY'S PILLAR



This is Pompey's Pillar, near Alexandria. It was erected to commemorate Diocletian's capture of the city. The Serapeum, the most famous of all Alexandrian temples, stood near this pillar.

This first glory of Alexandria was transient. When in the 7th century A.D. the Arab succeeded the Greek and Roman and ruthlessly destroyed her wonderful library, a long night of Egyptian darkness set in. Only in the 19th century, with the cutting of the Suez Canal and the British occupation of Egypt, did Alexandria regain something of her ancient greatness.

Alexandria was founded by the great Alexander in 332 B.C. It originally lay on the island of Pharos, connected with the mainland by a mole nearly a mile long which separated the two harbors. It soon spread over a large area on the mainland. The city was divided into three parts, the Jews' quarter, that of the Egyptians, and the royal or Greek quarter. Among the principal buildings of that day were the palace of the Ptolemies, and the temple of the Caesars beside which stood the two obelisks, known as "Cleopatra's needles," placed there by Julius Caesar in honor of the famous Egyptian queen. One of these obelisks stands in New York City today, the other in London.

Alexandria played a prominent part in Napoleon's Egyptian campaign of 1798, and was bombarded by the British in 1882 at the time of Arabi Pasha's rebellion against the Khedive.

Modern Alexandria shows few traces of the ancient city. The mole has become silted up and forms a neck of land, on which live most of the Mohammedan inhabitants. There is an Arab quarter with oriental bazaars, a large European quarter, and an industrial and manufacturing district with asphalt works, and oil, rice, and paper mills. The city is connected by canal with the Nile River and Cairo, and is linked by a network of railway and telegraph lines with other towns of Egypt. The chief exports are raw cotton, grain, rice, and sugar. Standing near the Suez Canal where East meets West, Alexandria is now, as in the days of old, one of the most cosmopolitan cities of the world. Population, about 445,000.

ALFALFA. It is estimated that to produce 100 pounds of beef, 1,000 pounds of grain is required when used with prairie hay, corn fodder, or millet; but that if alfalfa hay is fed with the grain, the amount of grain used may be reduced nearly one-half in producing the same amount of beef. It is also estimated that an acre of alfalfa in a season will sometimes produce 776 pounds of pork, where hogs are pastured on it. It is excellent for young stock because it is rich in protein.

Alfalfa will produce a crop every 40 days, and will average 2.52 tons of cured hay to the acre as against

1.22 tons for timothy and 1.29 for clover. It is cut when the plants are just coming into bloom, and yields from three to seven crops a year, depending upon the length of the season. Because of its frequent blossoming it is a good crop for honey bees.

WHAT A LOT OF NITRATE FACTORIES!



Alfalfa roots have more nitrate factories on them than there are manufacturing plants in Philadelphia or Chicago, and they are mighty important little factories, too.

This plant is also valuable as a nitrate gatherer. The free nitrogen is drawn from the air and stored in the plant roots by the action of certain bacteria which form nodules or knots on the plant roots. Alfalfa will not grow in an acid soil unfavorable to the growth of these bacteria, and such soils must be well limed before seeding to alfalfa. On fields where alfalfa has never been grown it may also be necessary to "inoculate" the soil with these bacteria, either by transferring soil from a field where alfalfa has flourished, or by treating the seed with a preparation containing these useful bacteria. (Such inoculating cultures can be

obtained from the Department of Agriculture at Washington.)

Alfalfa is an unusually hardy perennial and it can be grown in a great variety of climatic conditions. It grows on fields below sea-level in southern California, or at altitudes of 8,000 feet in Colorado; in the dry regions of the West, or in the Gulf states of heavy rainfall; in the tropical climate of the South, or in the Northwest where the winters are severe. After a growth or "stand" has once been obtained, there is rarely a crop failure, and alfalfa has been known to produce good crops from the same field for over 50 years.

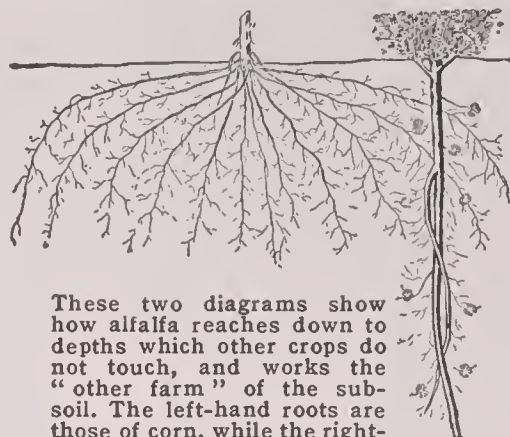
The hardiness of the plant and its ability to flourish where other crops fail is largely due to its unusually long roots. These are often 15 to 20 feet long and reach deep into the subsoil, drawing from a storehouse of moisture and nourishment untouched by other crops. For this reason it is a good crop to use in rotation with other crops which draw heavily upon the surface soil. Weeds are a serious enemy of the young alfalfa plants, so that it is well to plant alfalfa after a cultivated crop such as corn or potatoes.

What is called "alfalfa meal" is ground alfalfa hay. In this form it is fed without waste, and it is also shipped conveniently. Experiments have even been

made to adapt alfalfa to use as a food for human beings in candy, tonics, and breakfast foods.

Although alfalfa is one of the most recent arrivals in the fields of the United States and Canada, it is

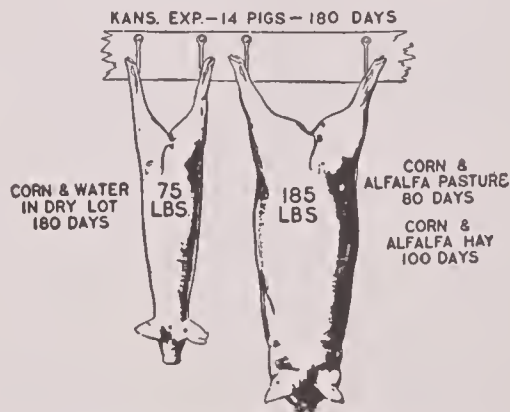
HOW ALFALFA FARMS ANOTHER FARM



These two diagrams show how alfalfa reaches down to depths which other crops do not touch, and works the "other farm" of the subsoil. The left-hand roots are those of corn, while the right-hand diagram shows the long alfalfa root.

one of the oldest forage crops known to man. It was grown in central Asia under the name of *al-faṣṣaḥ*, which means "the best feed," and was introduced into Greece at the time of the Persian wars. The Romans carried it from Greece into Italy and then to Spain and southern France. At the time of the Spanish conquests in the New World, alfalfa was brought to Mexico and South America. It arrived in California about 1854, probably brought by gold-

WHAT ALFALFA DOES FOR HOGS



This picture shows graphically what alfalfa will do for hogs. It gives the result of experiments on 14 pigs for 180 days at the Kansas Experiment Station.

seekers from Chile coming to California. The growing of alfalfa spread rapidly over the West, and gradually over the farms of the East, until it now yields an annual crop of hay and seed more than equal in value to the output of all the gold mines of the country.

Alfalfa is also called "lucerne" from the Swiss canton of that name. It is a clover-like plant belonging to the same family as the clovers, beans, lentils, peas, and other plants, which are called "leguminous" plants because their seeds are borne in pods or legumes.

Alfalfa has a smooth, upright, branching, hollow stem, one to two feet high. Many stems grow from one seed or root. The leaves are three-parted, arranged alternately,

and netted-veined. The flowers are purple, arranged in clusters on the stems and branches. The seed pods are coiled spirally, each containing several seeds, which are kidney-shaped and olive green or bright yellow in color. Scientific name, *Medicago sativa*.

ALFONSO, KINGS OF SPAIN. Thirteen rulers of Spain have borne the name Alfonso. ALFONSO XIII (1886-), the latest of these, was king from the time of his birth, for his father ALFONSO XII died a few months before his son was born. During the first 16 years of the young king's life his mother ruled for him. This was a time of violent disorders in the kingdom, and of foreign war (the Spanish-American War of 1898) by which Spain lost practically the last of its colonial possessions. Alfonso took personal charge of the government in 1902, and under his rule conditions have greatly improved. He is a democratic liberal ruler who has used his power for the benefit of his kingdom. His especial anxiety has been to introduce into Spain progress and religious freedom. He and his queen, Princess Ena of Battenberg, grand-daughter of Queen Victoria of England, are much liked, not only by their own people but also by all who meet them.

The name Alfonso (or Alphonso) has also been a favorite one in Portugal, where six kings have been so named, the last being ALFONSO VI of Portugal, who reigned 1656-1667.

ALFRED THE GREAT, KING OF ENGLAND (848-899). On a small lonely island amid the swamps of Wessex in southwestern England, King Alfred—"the wisest, best, and greatest king that ever reigned in England"—had sought refuge from his enemies, the Danes, who for a number of years had been plundering the land and overrunning the kingdoms. One day, so the story goes, Alfred was sheltered in a herdsman's hut, and the housewife, having to leave the hut for a few moments, bade her guest watch the cakes baking before the fire. This Alfred readily promised to do; but his mind soon turned to affairs of state and to plans for defeating the Danes; so when the woman returned she found her cakes burned to a cinder. An old English song represents her as scolding the king, whom she did not know, saying—

Can't you mind the eakes, man?
And don't you see them burn?
I'm bound you'll eat them fast enough,
As soon as 'tis the turn.

Why Alfred Sang for the Danes

Another story tells how Alfred went into the Danish camp disguised as a minstrel or wandering singer, in order to spy out the strength of the enemy. The Danes were so pleased with his singing that he had difficulty in getting away again. He then summoned his warriors from their homes, to which they had scattered at the end of the preceding campaign to care for their families and prepare their crops. With this newly formed army he then defeated the Danes in battle and drove them back into their fortified camp, where he besieged them for 14 days. Since they were now separated from their ships and

cut off from supplies, the Danish leader Guthrum made a treaty, in which he agreed to leave Alfred's kingdom and to accept Christianity. Later a new treaty was made which fixed the Thames River and the old Roman road called Watling Street as the boundary between Alfred's kingdom and the Danish lands north of it.

This treaty brought peace to the land and allowed Alfred to turn his attention to other pursuits than war. One of the things in which he was greatly interested was the encouragement of learning.

One day when he was only a young boy his mother had said to him and to his brothers: "Do you see this little book, with its clear black writing, and the beautiful letter at the beginning, painted in red, blue, and gold? It shall belong to the one who first learns its songs." "Mother," said Alfred, "will you really give that beautiful book to me if I learn it first?" "Yes," was her reply, "I really will." Alfred then took the book to his teacher and soon learned to repeat the verses.

Alfred the Scholar and Builder

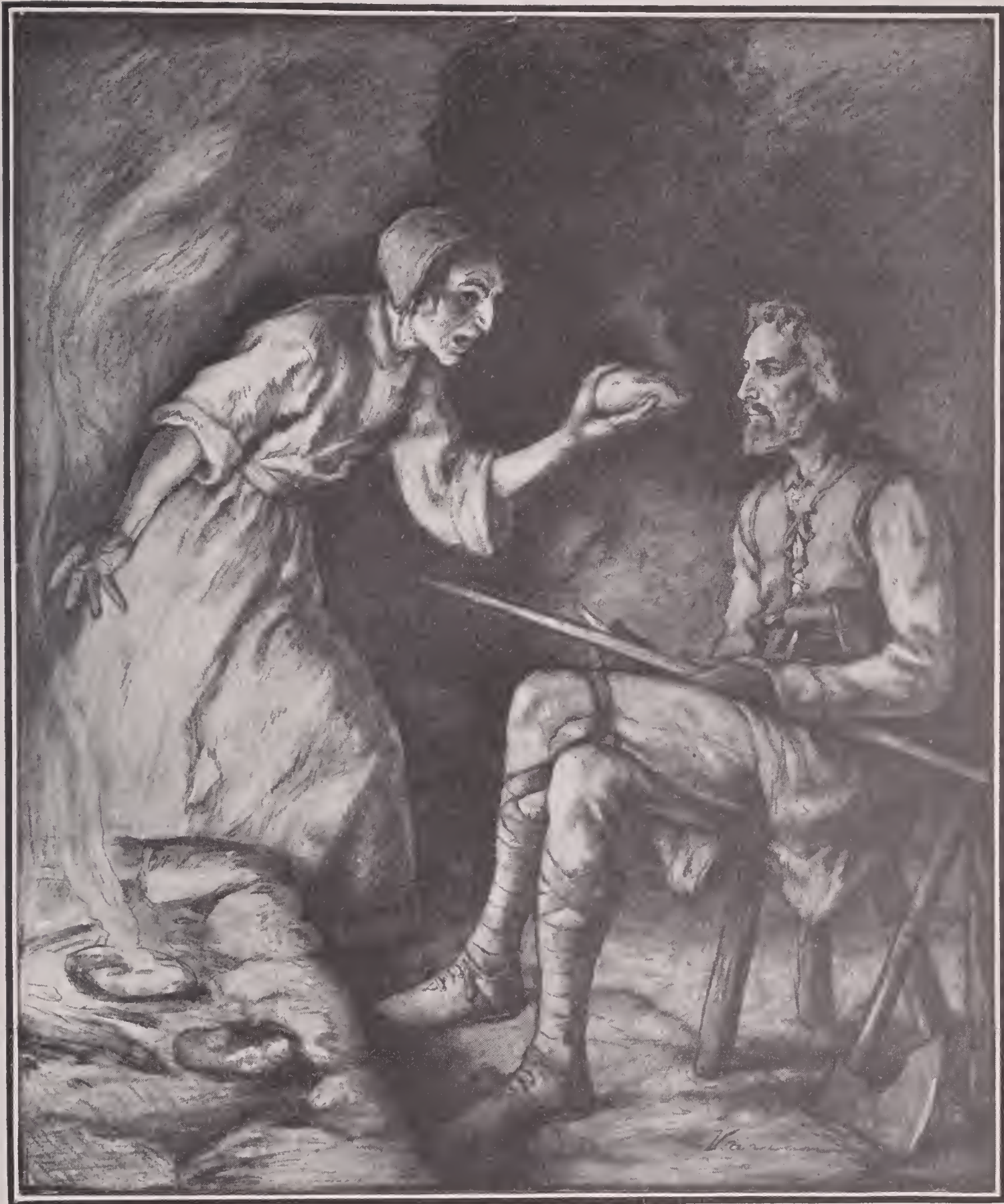
Now that he was king (871-899), Alfred invited learned men from other countries to his kingdom to instruct his people. He established a school similar to the Palace School of Charlemagne, and he translated a number of books from Latin into English, so that the people might read them. Under his direction was begun, also, the 'Old English Chronicle'. This is a record of events, year by year, kept by the monks, and from it we get most of our knowledge of that early time.

But not all of Alfred's time was devoted to books. He rebuilt London, which had been partially destroyed by the Danes. He improved the army so that his kingdom might never again suffer as it had from these Northmen. He saw that England needed a navy as well as an army, and so he began to build ships; for this he is known as the "father of the English navy." He encouraged industries of all kinds, and finally he collected and revised the old laws of the kingdom in order that justice might be attained more easily.

His aim was expressed in his own words: "To sum up all," he said, "it has ever been my desire to live worthily while I was alive, and after my death to leave to those that should come after me my memory in good works." That he succeeded in this is proved by the fact that the English cherished his memory as "England's Darling," and we now call him "Alfred the Great."

ALGAE (*āl'gē*). The first little plants were sailors. As they floated about in the water, the living drop of jelly-like material that we call protoplasm soaked food through the thin walls of the cells. One cell budded from another and broke away to start a new family, or clung to the parent cells to form a bead-like string, or a knot. Sometimes they budded all around the sides and formed mats and flat net-works of cells.

THE KING AND THE BURNING CAKES



Notice that far-away look in the king's eyes. His mind is evidently still working out plans for the defeat of the Danes, and as yet he scarcely hears the scolding voice. He has evidently been shaping a spear shaft with his knife, and he has his battle-ax by his side and his knife in his belt. It really must have been provoking to the hospitable herdsman's wife to find that a stranger, to whom she had freely given the hospitality of her humble home, wouldn't even watch the cakes for a few moments; and no doubt she said very much of what the old English song in our text represents her as saying.

Some of these nets and mats floated on rocks, in quiet places where the motion of the water was not strong enough to float them off again. As the rocks sheltered them, the plants were not so easily torn apart. The cells that lay on the rocks could not gather so much food, so they learned to cling, while

the floating cells gathered food, and budded and spread into feathery leaf-like fronds. The plants lived in a colony, you see.

How the Cells Divided Up the Work

So, by and by, they divided the labor just as people do in a village. It was the business of some plants or

contained in the Easy Reference Fact-Index at the end of this work

cells to cling to the rocks. Others waved in the water and gathered food. It wasn't necessary any longer, and there wasn't room for each cell to bud, although it could have done so. Certain cells began to collect budding material in little raised dots on the fronds. When these dots ripened they were washed off. These bud dots were spores. They were not seeds, they were just the hints of seeds; and the cells that clung to the rocks were hints of roots; and the cells that spread out and floated were hints of leaves. All together they formed—seaweeds! Seaweeds belong to the plant family called algae.

Algae are higher plants than fungi. They contain a green coloring matter called *chlorophyll*, which is absent from all fungi. This enables the plant to absorb part of the sunlight and use this force in making food. A green plant can take raw material like earth, air, and water, and with the aid of sunlight make its own food. The fungi cannot do this.

The "Adams" of the Plant World

Algae live only in the water, being found in oceans, rivers, lakes, ponds, marshes, and warm springs everywhere. Some of them are very beautiful, in a

great variety of forms and colors. The very commonest alga that you can all find, almost everywhere, is the green scum that forms on quiet ponds and swamps. This scum, which is known by the scientific name of *Spirogyra*, is all broken up into single plants, or knots and strings of cells, and can easily be separated and studied under a microscope.

Algae are of special interest as representing the most primitive forms of the plant kingdom, from which all other groups of plants have probably been derived. Some are only a single cell and are microscopic in size, while others are very complex and huge, as the giant kelps of the ocean. There are three great groups of algae. The *green algae* are the simplest, having no other pigment than the green chlorophyll. The *brown algae* have a yellowish to brown pigment in addition to the chlorophyll, which gives their bodies various shades from olive to yellow and brown. They include the common large and coarser seaweeds cast up by the waves. The *red algae* have a red pigment in addition to the chlorophyll, and their graceful and often very delicate bodies, beautifully tinted with various shades of red, are among the most attractive plants on the seashore. (See Seaweeds.)

ALGEBRA and the PROBLEMS It SOLVES

IT IS surprising how many more things you can do with a number by using Algebra than you can with Arithmetic. You can write out the answers to the hardest problems before you really know them yourself, and then—by the magic of Algebra—the whole puzzle is presently solved. Anyone can do this who takes the trouble to learn thoroughly a few fundamental laws of this fascinating game. These laws have helped men to discover the tremendous truths of Physics and Astronomy and thousands of other great scientific principles.

ALGEBRA. People sometimes think that algebra is only a form of arithmetic which uses letters instead of figures, and they wonder why pupils should be required to spend their time in mastering what seems a useless subject. Perhaps we can best see how mistaken this view is if we start with a very necessary algebraic idea, that of the *equation*, and see how useful it really is.

What an Equation Is

In order to find the weight of a bag of flour, it is placed on one pan of a pair of balanced scales. The flour, together with a 4-pound weight, balances 10 pounds of weights on the other pan. Now it is a well-known principle of balanced scales that if one takes the same amount from each pan, the balance is not disturbed. Hence, if we suppose that a 4-pound weight is taken from each pan, it is seen that the flour will be balanced by 6 pounds.

This solves the problem; but let us analyze it a little farther. The important fact in the problem is that an unknown number of pounds of flour plus 4 pounds in one pan balances 10 pounds in the other pan. If we agree to let W represent the number of pounds of weight in the bag of flour, and use the sign of equality to represent the perfect balance of the

scales, we can express the balance of weights as follows: $W + 4 = 10$. $W + 4$ represents the weight in the left pan, and 10 the weight in the right pan.

Such a statement as $W + 4 = 10$ expresses equality and is called an *equation*. The number on the left side of the equality sign is called the *left member* and the number on the right side the *right member*.

The written work of the problem may be arranged as follows:

Let W = number of pounds of weight in the bag of flour.

Then $W + 4 = 10$ is the equation expressing the conditions of the problem.

Subtracting 4 from each member of the equation—

$$\begin{array}{r} W + 4 = 10 \\ 4 = 4 \\ \hline W = 6 \end{array}$$

the number of pounds of weight in the bag of flour.

Just as the scales will balance if the same number of pounds be taken from each pan, so we may subtract the same number (4) from each side of the equation and get another equation.

By means of the equation and the use of letters (usually X and Y) to represent unknowns, we can

shorten and simplify the labor that is often necessary in arithmetic. This method of solving problems is called algebraic and every educated person should be able to use it freely.

Four Thousand Years of Algebra

Algebra has had a long and interesting history. It had its beginnings in ancient Egypt, about 2000 B.C., when some unknown mathematical writer discovered the principle of the equation. In the treatise which he wrote he used the Egyptian word *hau* (literally "heap") instead of the letter *X* for the unknown quantity. In the British Museum, in London, there is shown a papyrus manuscript containing a copy of this most ancient mathematical book in the world, copied by a scribe named Ahmes about 1700 B.C.

In the days of Alexander the Great a certain learned Syrian is said to have written a work on algebra which he called by a Syriac title meaning "the book of dark or mysterious things." Seven hundred years later (about 350 A.D.), Diophantus, a Greek who taught in Alexandria, Egypt, earned the title "Father of Algebra" by his systematic attempts to work out the science. The name of the science was derived from the word *Al-jabr* (Arabic, meaning "binding together") in the title of a famous work written by a Mohammedan mathematician of Bagdad, about the year 800. Algebra did not assume its present form until the 16th century. Even since that time many interesting and valuable improvements have been made, so that now a boy or girl in the first year of the high school can get a broader view of algebra than learned men were able to get in the old days.

Algebra and Arithmetic Compared

In some respects algebra is very much like arithmetic. In arithmetic, for example, we study how to add, subtract, multiply, and divide with numbers represented by the digits 1, 2, 3, 4, etc. In algebra we continue to study how to use the processes of

addition, subtraction, multiplication, and division with numbers, but the numbers are regularly represented by letters, as is sometimes done in arithmetic. Thus, the interest rule often used in arithmetic, *the interest for a given time equals the principal times the rate multiplied by the time*, is in the algebra work always

translated into the statement $I = PRT$, that is, Interest = Principal $\times$ Rate $\times$ Time. Such a use of letters enables us to write statements in very concise forms.

The signs $+$, $-$, $\times$, $\div$, $=$, and $\sqrt{\quad}$ have the same meaning in algebra as in arithmetic. But in algebra *ab* means *a* times *b* without the use of any sign. A dot is also used at times instead of the sign $\times$ to indicate multiplication, thus $a \cdot b$ is read *a* times *b*.

When a group of letters is to be multiplied or divided as a unit by some other letter, we inclose the group in parenthesis marks. Thus $a(b + c)$ means that *a* multiplies both *b* and *c*, or that *b* and *c* must be added and the sum multiplied by *a*, which is the same as multiplying *b* and *c* separately by *a* and then adding the products.

Many problems may be solved either by arithmetic or by algebra. Algebraic and arithmetical solutions are given in contrast in the problem below:

Divide a pole 20 ft. long into two parts so that one part shall be four times as long as the other part.

ARITHMETICAL SOLUTION

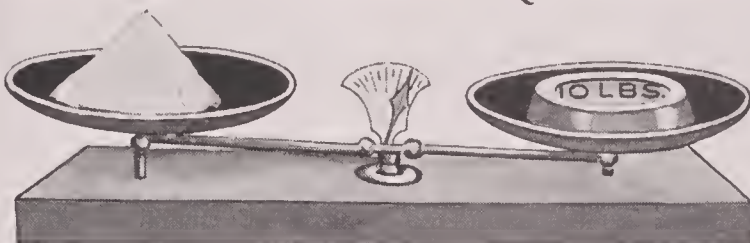
The shorter part is a certain length.
The longer part is four times this length.
The whole pole is then five times as long as the shorter part.
The pole is 20 ft. long.
The shorter part is one-fifth of 20 ft., or 4 ft.
The longer part is 4×4 ft., or 16 ft.
Hence the parts are 4 ft. and 16 ft. long respectively.

ALGEBRAIC SOLUTION

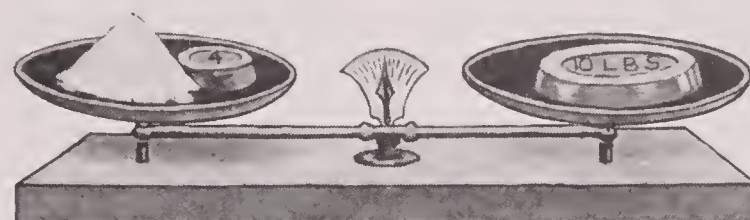
Let n = number of feet in the shorter part.
Then $4n$ = number of feet in the longer part,
and $n + 4n$, or $5n$ = length of the pole.
Then $5n = 20$.
 $n = 4$.
 $4n = 16$.

Hence the parts are 4 ft. and 16 ft. long respectively.

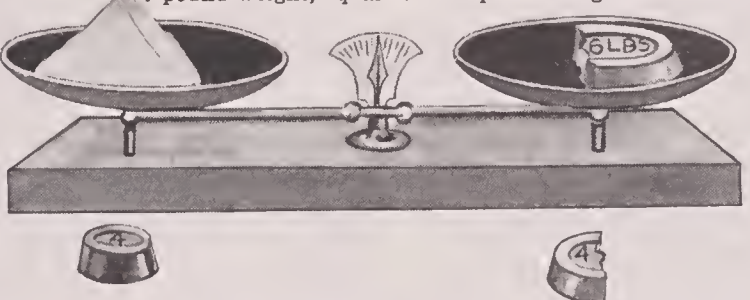
WHAT AN ALGEBRAIC EQUATION IS



Here is a simple example of the uses of algebra. Let's suppose we want to find the weight of the sugar in the left pan of the scale, and we can't find a weight which balances it exactly. The 10-pound weight is too heavy, the others are too light. We begin by calling the weight of the sugar x , which in algebra always stands for the "unknown quantity."



We now discover that by putting a 4-pound weight beside the sugar, the scale balances. Now, a correct algebraic equation is just like a balanced scale. It always tells you that the things on one side of the equation mark are exactly equal to the things on the other. So we can write the equation for this balanced scale as follows: $x + 4 = 10$, which means that the weight of the sugar added to the 4-pound weight, equals the 10-pound weight.



An equation, like a scale, will always remain correctly balanced if the same quantity is added to or subtracted from both sides at once. We may, therefore, subtract 4 from both sides of our equation, thus: $x + 4 - 4 = 10 - 4$. The $+4$ and the -4 cancel each other, giving us $x = 10 - 4$, or $x = 6$, which is our answer. It is just as if we had taken off the 4-pound weight from one side of the scale and had broken off a 4-pound piece from the 10-pound weight on the other side.

The statement $5n = 20$ is called an *equation*. The "literal" (letter) number n is called the *unknown*. The equation is said to be solved when the correct value of the unknown is found. Thus $n = 4$ is the solution of the equation $5n = 20$. Such a value is called a *root* of the equation. Thus 4 is a root of the equation $5n = 20$ because when 4 is put in place of n the equation is true. This is called *checking* the solution.

Fundamental Laws in Solving Equations

There are four fundamental laws used in solving equations. They are the addition law, the subtraction law, the multiplication law, and the division law. These laws will now be given and illustrated.

Addition Law.—"If the same number be added to both sides of an equation, another equation is obtained." E.g., in the equation $4x - 2 = 10$, if we add 2 to each side of the equation, the result is $4x = 12$. We can find $x = 3$ by dividing both sides of the equation, $4x = 12$, by 4.

Division Law.—This last step illustrates the use of the division law, which says, "If both sides of an equation be divided by the same number (excluding division by zero), another equation is obtained."

Subtraction Law.—"If the same number be subtracted from both sides of an equation, another equation is obtained." E.g., in the equation $3x + 4 = 16$, if we subtract 4 from both sides of the equation, we get $3x = 12$, whence, by the division law, $x = 4$.

Multiplication Law.—"If both sides of an equation be multiplied by the same number, another equation is obtained." E.g., in the equation $\frac{x}{3} = 5$, if we multiply both sides of the equation by 3, then $x = 15$.

Kinds of Equations and Their Use

Equations are of two kinds, *identical* and *conditional*. An identical equation, or an identity, is an equation that has no letters in it, or that is true for all values of the letters. Thus $2 + 4 = 6$ and $7x = 10x - 3x$ are identities. The identity is the declarative sentence of algebra and states that the two sides of the equation are the same except for form. A conditional equation is an equation which is true only for certain values of the unknown. Thus $5x + 2 = 12$ only on the condition that $x = 2$. The conditional equation is the interrogative sentence of algebra and always asks for what values of the unknown the equation will be true.

The equation is indispensable in solving what are commonly known as *verbal* or *thought* problems like the one on page 93, where it is required to find the two parts of a pole 20 feet long. As a rule it is not difficult to solve the equation once the correct equation is obtained, but often one may make a mistake in interpreting the conditions of the problem. The following important steps in the algebraic solution of verbal problems may be helpful:

(a) In every problem certain facts are given as known and one or more as unknown and to be determined. Read the problem so as to get these facts clearly in mind.

(b) In solving the problem denote one of the unknown numbers by some symbol, as y .

(c) Then express all the given facts in algebraic language, using the number y as if it, too, were known.

(d) Find two different expressions which denote the same number, and equate them. Join by the sign of equality ($=$).

(e) Solve the equation for the value of the unknown number.

(f) Check the result by re-reading the problem, substituting the result in the conditions of the problem to see if these conditions are satisfied. Note that it is not sufficient to check the equation, for you may have written the wrong equation to represent the conditions of the problem.

If the only difference between arithmetic and algebra lay in the fact that letters are used to represent numbers instead of the ordinary digits, we should have merely literal arithmetic. But when the study of algebra is begun new kinds of numbers are introduced called *relative* numbers or *signed* numbers. In arithmetic the addition of two numbers is always possible, but it is not always possible to subtract. If the subtrahend is larger than the minuend we cannot subtract in arithmetic—the problem would have no meaning. In algebra, however, subtraction is always possible because of signed numbers. *Signed numbers* are numbers which are given two opposite senses or directions. These two opposite senses or directions are distinguished by calling one number *positive* and the other *negative*. Either may be called the positive number, but the number which has the opposite sense is always negative. Thus, if a distance to the right of some starting point (called the zero point) is positive, then the distance to the left of the zero point is negative. All real numbers are usually represented on a line called the number line and extending from the zero point in two opposite directions. A positive number is denoted by $+$, and a negative number by $-$. If no sign is given it is understood that the number is $+$.

The Four Fundamental Operations

The fundamental operations of addition, subtraction, multiplication, and division (except by zero) are always possible with positive and negative numbers.

The four laws governing these fundamental operations are as follows:

Addition Law.—If the two numbers to be added are positive, the sum is clearly positive; if negative, the sum is negative. Therefore, to add two algebraic numbers of like sign, find the sum of the two numbers arithmetically and prefix to the sum their common sign. Thus, the sum of $+5$ and $+10$ is $+15$; of -7 and -5 is -12 . If the two numbers to be added have opposite signs, find the difference of the numbers arithmetically and prefix the sign of the larger number. Thus, the sum of $+15$ and -8 is $+7$.

Subtraction Law.—In subtraction we are always concerned in finding a number called the difference which when added to the subtrahend will give the minuend. Thus, -4 subtracted from 6 equals 10 because $-4 + 10 = 6$, and -12 subtracted from $-17 = -5$ because the sum of -12 and -5 equals -17 . The result of subtracting any number, say b , is the same as adding $-b$. Therefore, to subtract one algebraic number from another change the sign of the subtrahend and add.

Multiplication Law.—There are four possible cases of the multiplication of positive and negative numbers. Illustrations will make the law clear. Since multiplication is a short process of addition, $(+4)(+3) = (+4) + (+4) + (+4) = +12$. Likewise $(-4)(+3) = (-4) + (-4) + (-4) = -12$. Then if we assume that positive and negative numbers follow the law for arithmetic numbers, and since we know in arithmetic that $3 \times 4 = 4 \times 3$, then $(+4)(-3) = (-3)(+4) = -12$. If in multiplying (-4) by (-3) the -3 were $+3$, we should get -12 as a product, but since the multiplier is -3 we get $(-4)(-3) = +12$. These examples illustrate the law of signs for multiplication which is as follows: *The product of two algebraic numbers of like signs is positive. The product of two algebraic numbers of unlike signs is negative.*

Division Law.—Since in division we are concerned with finding one of two numbers called the quotient which when multiplied by another number called the divisor will give the dividend, it is clear that

- (1) $(+8) \div (+2) = +4$, because $(+2)(+4) = +8$.
- (2) $(+8) \div (-2) = -4$, because $(-2)(-4) = +8$.
- (3) $(-8) \div (+2) = -4$, because $(+2)(-4) = -8$, and

- (4) $(-8) \div (-2) = +4$, because $(-2)(+4) = -8$.

Therefore the law of signs for division is as follows: *The quotient of two algebraic numbers of like signs is positive. The quotient of two algebraic numbers of unlike signs is negative.*

A one-termed number is called a *monomial*, a two-termed number a *binomial*, a three-termed number a *trinomial*, and so on. A *polynomial* is an expression containing two or more terms. Thus $3x^2$ is a monomial, $2a + 3b^2c$ is a binomial, $3x^2 + 4x + 6$ is a trinomial. Monomials may be added by adding first the positive terms and the negative terms and then finding the sum of these results. Thus, $27x + (-14x) + (-11x) + (21x) = +23x$. The method of adding polynomials is illustrated below.

$$\begin{array}{r} 9x + 3y + 2z \\ 5x - 4y + 6z \\ -3x - 8y - 5z \\ \hline 11x - 9y + 3z \end{array}$$

In the monomial $2x^3y^4$ the 2 is called the *coefficient* of the term, and the 3 and 4 are called *exponents*. The exponent indicates how many times the letter is to be used as a factor. The degree of a monomial is indicated by the sum of all the exponents in the monomial, and the degree of a polynomial is given by the term of highest degree in the polynomial. Thus, $x^5 + x^3 + x^2 + 1$ is of the fifth degree in x , and $x - 2xy^2 + y^3$ is of the third degree in y and first degree in x . The subtraction of one polynomial from another is shown below.

$$\begin{array}{r} 4x^2 - 3xy + 6y^2 \\ 3x^2 - 5xy - 7y^2 \\ \hline x^2 + 2xy + 13y^2 \end{array}$$

Type Products

One of the simplest products is that of multiplying a polynomial by a monomial. Before this type can be fully understood one must know that when two numbers with exponents are multiplied together (say $a^3 \cdot a^5$), the product is the number with an exponent equal to the sum of the original exponents. Thus, $a^3 \cdot a^5 = a^8$.

If we multiply $a^2 - 2ab + 3b^2$ by $3a$, each term of the polynomial must be multiplied by the monomial and the resulting products added. For example, $3a(a^2 - 2ab + 3b^2) = 3a^3 - 6a^2b + 9ab^2$. The product of

two polynomials is found by multiplying every term of one polynomial by each term of the other polynomial and adding these products. Thus $(x^2 + 2xy + y^2)(x + y) = x^3 + 3x^2y + 3xy^2 + y^3$.

The work often appears as follows:

$$\begin{array}{r} x^2 + 2xy + y^2 \\ x + y \\ \hline x^3 + 2x^2y + xy^2 \\ + x^2y + 2xy^2 + y^3 \\ \hline x^3 + 3x^2y + 3xy^2 + y^3 \end{array}$$

There are certain type products that one should study carefully because this enables him later to see the factors of certain expressions more readily. The first of these is the product of multiplying a polynomial by a monomial. If one knows clearly that $2a(3x^2 + 4y + 6bz) = 6ax^2 + 8ay + 12abz$, he can more easily find the two factors of $6ax^2 + 8ay + 12abz$. The terms of $6ax^2 + 8ay + 12abz$ are said to be *similar* terms because they each contain the factor $2a$. In trying to factor any algebraic expression one should therefore always look for a monomial factor which is common to all of the terms of the expression.

The second type product with which one should be familiar is the product obtained by multiplying two binomials together. The following examples will illustrate the method:

1. $(2x + 3)(4x + 5)$.

$$\begin{array}{r} \text{SOLUTION: } 2x + 3 \\ 4x + 5 \\ \hline 8x^2 + 12x \\ + 10x + 15 \\ \hline 8x^2 + 22x + 15 \end{array}$$

2. $(3a + 5)(2a - 8)$.

$$\begin{array}{r} \text{SOLUTION: } 3a + 5 \\ 2a - 8 \\ \hline 6a^2 + 10a \\ - 24a - 40 \\ \hline 6a^2 - 14a - 40 \end{array}$$

3. $(5y + 4)(5y - 4)$.

$$\begin{array}{r} \text{SOLUTION: } 5y + 4 \\ 5y - 4 \\ \hline 25y^2 + 20y \\ - 20y - 16 \\ \hline 25y^2 - 16 \end{array}$$

4. $(2x + 3)(2x + 3)$.

$$\begin{array}{r} \text{SOLUTION: } 2x + 3 \\ 2x + 3 \\ \hline 4x^2 + 6x \\ + 6x + 9 \\ \hline 4x^2 + 12x + 9 \end{array}$$

If we agree to use the binomials $ax + b$ and $cx + d$ to represent any two binomials where a , b , c , and d are known numbers like those in the products above, then we may discover a short cut in multiplying $ax + b$ by $cx + d$.

Illustrative Example

Find the product of $(ax + b)$ and $(cx + d)$.

$$\begin{array}{r} \text{SOLUTION: } ax + b \\ \quad \times \quad cx + d \\ \hline acx^2 + bcx \\ + adx + bd \\ \hline acx^2 + (bc + ad)x + bd \end{array}$$

The arrows show the cross-multiplications or cross-products whose sum is equal to the middle term. It is seen that *the first term of the product is the product of the first terms of the binomials, that the last term is the product of the last terms of the binomials, and that the middle term is the sum of the two cross-products.*

Products like those above can all be factored easily by inspection or by what is often called the "cut and try" method.

The method consists simply of guessing the correct pair of factors from all the possible ones and then verifying the result by multiplying the factors together. The method is illustrated by the following example:

Factor $2x^2 + 9x + 10$.

SOLUTION: There are four possible pairs of factors, as shown below:

$$\begin{array}{cccc} \underline{2x + 10} & \underline{x + 10} & \underline{x + 5} & \underline{2x + 5} \\ \underline{x + 1} & \underline{2x + 1} & \underline{2x + 2} & \underline{x + 2} \end{array}$$

It is clear that the last pair is the correct one, since the sum of the cross-products is $9x$.

It is very important always to be sure that the factors obtained are prime numbers. Such factors are called *prime factors*. Incidentally it is important to remember that there are some numbers that are not factorable, because they are already prime numbers. For example, $x^2 + 16$ and $x^2 + 2x + 12$ are not factorable.

From what has been said one can see that in all factoring problems it is important to hold in mind three things, namely:

- (1) Try to discover a common monomial factor.
- (2) Find the prime factors by the "cut and try" method.
- (3) Check by multiplying the factors together.

Division of Algebraic Polynomials

The process of dividing one algebraic polynomial by another is clearly illustrated by a division problem from arithmetic. Consider $67,942 \div 322$.

If we arrange dividend and divisor in the form of polynomials, the division may appear in either of the following forms:

$$\begin{array}{r} 60000 + 7000 + 900 + 40 + 2 \quad | \quad 300 + 20 + 2 \\ \underline{60000 + 4000 + 400} \quad | \quad \underline{200 + 10 + 1} \\ 3000 + 500 + 40 \\ \underline{3000 + 200 + 20} \\ 300 + 20 + 2 \\ \underline{300 + 20 + 2} \end{array}$$

$$\begin{array}{r} 6 \cdot 10^4 + 7 \cdot 10^3 + 9 \cdot 10^2 + 4 \cdot 10 + 2 \quad | \quad 3 \cdot 10^2 + 2 \cdot 10 + 2 \\ \underline{6 \cdot 10^4 + 4 \cdot 10^3 + 4 \cdot 10^2} \quad | \quad \underline{2 \cdot 10^2 + 10 + 1} \\ 3 \cdot 10^3 + 5 \cdot 10^2 + 4 \cdot 10 \\ \underline{3 \cdot 10^3 + 2 \cdot 10^2 + 2 \cdot 10} \\ 3 \cdot 10^2 + 2 \cdot 10 + 2 \\ \underline{3 \cdot 10^2 + 2 \cdot 10 + 2} \end{array}$$

The division of algebraic polynomials arranged according to either of the ascending or the descending

power of some letter is similar to the preceding division of arithmetical numbers; thus:

$$\begin{array}{r} 8y^4 + 6y^3 + 9y^2 + 3y + 2 \quad | \quad 4y^2 + y + 2 \\ \underline{8y^4 + 2y^3 + 4y^2} \quad | \quad \underline{2y^2 + y + 1} \\ 4y^3 + 5y^2 + 3y \\ \underline{4y^3 + y^2 + 2y} \\ 4y^2 + y + 2 \\ \underline{4y^2 + y + 2} \end{array}$$

$$\begin{array}{r} \text{or} \\ a^3 + b^3 \quad | \quad a + b \\ \underline{a^3 + a^2b} \quad | \quad \underline{a^2 - ab + b^2} \\ -a^2b + b^3 \\ \underline{-a^2b - ab^2} \\ +ab^2 + b^3 \\ \underline{+ab^2 + b^3} \end{array}$$

Advantages of Algebra

In trying to express our ideas we are often impressed by the lack of clearness and conciseness in our statements. This is due to the fact that words and phrases as instruments for certain kinds of investigations and precise statements are often weak and deficient. A knowledge of algebra enables one to correct many of these shortcomings and to supplement or replace words and phrases by symbols.

For example, if one should want to say "the square of the number of books in the library," he can do this quickly by using X^2 where X represents "the number of books in the library." What is more, one can perform any of the four fundamental operations on X^2 without having to hold in mind all the time what X stands for. Thus, the use of symbols constitutes a powerful kind of shorthand and furnishes us with a method of solving many interesting and important problems.

Again the formula for the area of a triangle, namely, $A = \frac{ab}{2}$, is an arrangement of symbols, clear and concise, which is more effectively handled than the words and phrases which the symbols replace.

ALGERIA. One of the most prosperous and civilized parts of Africa is the French possession of Algeria, situated on the north coast directly across the Mediterranean from the mother country. France here has pursued the wise policy of allowing the intelligent native Arabs and Berbers to govern themselves as far as possible, with the result that the natural enmity between Mohammedan and Christian has been largely forgotten. In fact Algeria is no longer looked upon as a colony, but as a regular portion of France, divided into three departments—Oran, Constantine, and Algiers—each of which sends one senator and two representatives to the French parliament in Paris. The natives have their own courts and *cadis*, or judges, under the supreme authority of the French governor-general.

Resources of Algeria

Algeria lies between Morocco on the west and Tunis on the east. On the south the civil boundaries extend about 350 miles inland, but the desert districts

under Algerian military rule stretch 400 miles farther into the Sahara. Two spurs of the great Atlas mountain range cross Algeria. The district along the seacoast, called "The Tell," is well watered by rivers



A Native of Algeria

and consists of highly fertile plains and valleys, where French and native farmers raise wheat, barley, oats, corn, potatoes, beans, tobacco, and flax. Here also, in the warmer lowlands, thrives a great fruit industry, producing quantities of dates, oranges, mandarins, citrons, bananas, pomegranates, almonds, olives, and figs. Enormous supplies of wine are also manufactured every year.

South of The Tell are high plateau lands where millions of sheep and goats and thousands of cattle find pasturage. Beyond is the main Atlas ridge, enclosing smaller areas of rich lands, largely cultivated by the Kabyle tribes. A further stage brings us to the desert which is barren except for the extraordinarily fertile oases, most of them produced by artesian wells.

The mountains of Algeria themselves yield important quantities of iron, zinc, lead, copper, mercury, antimony, and petroleum, while the nearby seas produce sardines, anchovies, and tunny for export. The silk trade is also extensive.

Algeria has 3,500 miles of excellent government roads, which are not only of immense commercial value, but which make the beautifully picturesque country a paradise for the thousands of motorists attracted every year by the excellent climate. A network of more than 2,000 miles of railway lines pene-

trates to all parts of the province, and each year sees the rails pushed farther southward into the desert.

The capitals of the departments and the three most important towns are: Algiers (population, 172,000), Oran (123,000), and Constantine (65,000). Algiers presents a strange combination of an ultra-modern city and an ancient Arab settlement; it has a fine harbor, distinguished by the fact that it was the first ever constructed with blocks of concrete. The suburbs are filled with beautiful villas and splendid hotels, which are always crowded during the winter season.

The Famous Foreign Legion

In Algeria is the headquarters of the famous Foreign Legion of France, recruited from adventurous spirits from all parts of the world, which so distinguished itself in the World War of 1914-18. In this war Algeria not only provided many men to the French armies, but contributed also large supplies of food, principally mutton for the French and British armies, and war supplies of many sorts.

The French seizure of Algeria originated as the result of an altercation, in 1827, over a debt between France and the Algerian government, when the ruler, Dey Hussein, struck the French consul with a "fly-swatter." War resulted, and in 1830 the town of Algiers surrendered. Population, 4,750,000 natives, 752,000 Europeans.

ALHAMBRA. The marvelously beautiful residence and fortress of the Moorish rulers of Granada, situ-



This relief map of Algeria and the neighboring territory shows how the face of the whole land would look if viewed from above. Near the northern coast you see the region which contains the well-watered and fertile plains and valleys called "The Tell," where the farmers raise grains, tobacco, and flax; and where grow oranges, olives, and figs. South of this the land is not sufficiently fertile for profitable fruit or grain farming and is given over to pasturage. After this comes the desert, where nothing grows except in the oases.

ated on a hill overlooking that city. It was begun in 1248 and completed in 1314. (See Spain.)

ALKALI. Caustic soda and caustic potash are familiar examples of the important group of chemical compounds called alkalies, which have the property of neutralizing acids. They are extensively used in soap-making, dyeing, and many other industries. (See Acids and Alkalies.)

ALLEN, ETHAN (1737-1789). Soon after the battle of Lexington this Vermont frontiersman marched against the fortress of Ticonderoga on Lake Champlain commanding the road from Canada to New York. Landing with 93 men just before daybreak, he surprised the fort, getting inside and forming his men on parade ground before they woke the sleeping garrison with a shout of victory. The British commander rushed out in his nightclothes and asked: "What does this mean?" He was ordered to surrender. "In whose name?" he asked. "In the name of the Great Jehovah and the Continental Congress," replied Allen.

Ethan Allen was a type of the rugged unlettered pioneer, ready to fight at a moment's notice. We first find him in 1771 at the head of the "Green Mountain Boys," a force organized to resist the authority of the colony of New York in the "New Hampshire Grants" of Vermont, in which he lived. When the colonies came into conflict with the mother country, in 1775, Allen with his men was as ready to resist the authority of England as he had been to resist that of New York.

After capturing Ticonderoga, Allen joined the expedition against Canada, but he was captured near Montreal and held until 1778. Upon his release he was made brigadier-general of the Vermont militia and was also appointed a delegate to persuade Congress to admit Vermont as a state into the Union. In this last he failed, and as a result Allen and his brother Ira entered into a correspondence with the British in Canada upon which an unsubstantiated charge of treason was later based. He did not live to see Vermont become a state in the Union in 1791.

ALLIGATOR. One of the ugliest and most formidable-looking of all animals is the alligator, a large reptile which inhabits the waters of the southern Mississippi and Florida. It sometimes reaches a length of 15 or 20 feet, and it has a body covered with an armor of horny scales. Alligators have been known to show great boldness and ferocity in attacking human beings, sometimes seizing them and carrying them away; but in places where they have been much hunted they have become timid.

Related to the Crocodile

The alligator is related to the crocodile of Asia and Africa, but differs from it in having a broader head and a blunter snout. Also, its lower teeth fit into

pits in the upper jaw, while those of the crocodile slide outside of the jaw and are visible.

One species of alligator has been found in China, but most of these animals live in the rivers and swamps of the southern United States and South America. The long powerful tail enables the alligator to swim with great ease and rapidity, but owing to its short legs and unwieldy body, its movements on land are slow and difficult. Its chief food is fish, but it is also fond of small reptiles, and devours dogs and other quadrupeds when it can get them.

What a Queer Way to Build a Nest!

During the winter months the alligator buries itself in the mud, but with the coming of warm weather it reappears. It may then be seen basking in the sun, and at times the loud roar of the males reverberates like thunder.

MRS. ALLIGATOR AND HER "CRATE" OF EGGS



It does look very much as if Mrs. Alligator had put her eggs in a rude sort of crate and intended to take them to market, doesn't it? But, as you learn in the article, this is her way of making her nest, which at the same time is to serve as an incubator for bringing the baby alligators into the world. You can see, too, that although she doesn't hatch her eggs, she keeps close watch for any intruders that are disposed to disturb them.

The female alligator lays a great number of eggs with hard shells, which in size and general appearance resemble hens' eggs. The nests are built in a curious manner. Along the bank is spread a layer of mud and grass or leaves; on this is placed a layer of eggs, then another layer of mud and grass about seven or eight inches in thickness, then another layer of eggs carefully covered, and so on, until often 30 or more eggs are deposited. Although the eggs are hatched by the heat of the sun and the decaying vegetable matter, the mother alligator watches the nest carefully. As soon as the young, which are helpless little creatures about eight inches long, are hatched, she leads them to the water and takes care of them as a hen does her brood of chickens, until they are strong enough to defend themselves. The whining and yelping of the young as they follow the mother about resemble that of young puppies.

Alligators have been so much hunted for sport and for their hides, which make a valuable leather, that their numbers have greatly decreased. Their horny scales cannot be penetrated except by the bullet of a high-power rifle, but they are easily wounded behind the foreleg and in the belly.

During the winter months, when they are in a torpid condition, they are often dug out of the mud and killed. Scientific name of common alligator, *Alligator mississippiensis*. (See Crocodile.)

ALLOYS'. A good tool steel, according to the saying, is much like a good man, for it must be able to "get hot without losing its temper." When machine lathes for cutting hard steel shafts and the thousands of other accurately turned and gauged parts in modern mechanism came into general use, a great need arose for tougher tool steels, for the ordinary chisels and similar tools softened and lost their "temper" when the friction of cutting heated them. The necessity of keeping the tools cool limited the speed of the machines.

What Robert Mushet Found

One day in 1868 an English metallurgist, named Robert F. Mushet, noticed that a steel tool with which he was cutting metal at a lathe did not lose its edge even when heated red hot by friction. He had the steel analyzed and found that it was an alloy or mixture of steel and tungsten, a metal little known in those days. Since then it has been found that certain other metals, when mixed with steel in just the right proportions, will give the alloy this same quality. Among them are chromium, vanadium, cobalt, manganese, and molybdenum. The discovery of these "high-speed" steels, as they are called, revolutionized metal-working the world over. During the World War of 1914-18, the British Government discovered a new "super-steel" alloy for making tools, which it is claimed takes off metal faster and keeps its edge longer than any other tool metal known. Its composition is molybdenum, 5.75 per cent; chromium, 2.79 per cent; vanadium, 1.29 per cent; carbon, .75 per cent; and the rest pure iron.

Some lathe tool alloys contain no steel at all. Thus chromium, tungsten, and cobalt in the proper proportions make "star-stone," or "stellite," which not only keeps a hard cutting edge but gets tougher as it gets hotter.

Such "high-speed" tools enable us in turn to mill the hardest and toughest possible alloys in building our machinery and of course the stronger our materials, the lighter and better become our machines.

Although nearly all metals are used in alloy form, the alloys of steel and iron are by far the most numerous and the most useful. Nor does the nature of an alloy depend alone on the kind of metals used, for often it is greatly altered by varying the proportions of the same metals.

It is possible for great flying machines to skim through the air because engines can be built of these new alloys that weigh no more than two pounds per horse-power. When a proportion of manganese is added to steel, it becomes so hard that it cannot be machined, but has to be cast or ground into shape. This steel makes armor plate that cannot be pierced except with projectiles pointed with the same material. The same is true of molybdenum steel, which because

it does not crack is much used for gun linings, airplane struts, and propeller shafts.

Chrome steel, hard and elastic, is valuable for files, projectiles, and balls for ball-bearings.

Use in Electrical Appliances

The finely drawn wire in our electric toasters, which leaps to cherry redness when the electric current is turned on, is an alloy of nickel and chromium. The discovery of this alloy made electrical appliances practical, as it provided a heating element which did not burn out easily.

Men have long known that the admixture or alloy of two or more metals serves useful purposes which neither alone could serve. Thus pure copper is not suitable for many purposes, but when it is alloyed with zinc it forms brass, which is harder than copper and tarnishes less readily. Gold and silver, when pure, are very soft and easily worn away. They are usually hardened, therefore, by alloying them with other metals in different proportions. "Sterling" silver for example is composed of 9.25 parts silver and .75 parts copper.

An interesting alloy is type metal, from which is cast the type used in printing books and newspapers. It is composed of lead and antimony, sometimes with the addition of small parts of tin and bismuth. Most substances expand with heat, but the opposite is true of type metal. In cooling it expands and fills the finest details of the type-mold, so that the letters print sharp and clear.

Other alloys are bronze, which contains copper and tin, and sometimes zinc, aluminum, or other metals; German silver, made of copper, zinc, and nickel; pewter, made of tin and copper; babbitt metal, a special mixture of tin, copper, and antimony; and solder, which is made of various alloys of tin, lead, zinc, copper, bismuth, gold, and silver. Amalgams are alloys which contain mercury.

ALMOND (ä'mönd). Although the almond tree has long been cultivated on account of its beautiful flowers and delicious nuts, we never see it in a wild state. Even as far back as Bible times it was grown and highly prized in Syria and Palestine. It probably originated in this region or somewhere along the Mediterranean, and strange as it may seem it belongs to the great rose family, which includes most of the fruit trees, and is a close relative of the plum.

The almond tree is of moderate size, reaching a height of from 20 to 30 feet. The delicate white or pink flowers appear early in the spring and are followed by the leaves, which are oval, pointed, and notched at the edges. The fruit has a soft outer coat enclosing the shell, within which is the seed or kernel.

The tree which has white blossoms produces bitter almonds; the one with pink blossoms bears sweet almonds. Bitter almonds are used in the manufacture of flavoring extract and various drugs used in medicine. Sweet almonds are classified as hard-shelled and soft-shelled. The almond of commerce belongs mainly to the soft-shelled group and those with the thinnest shells are called "paper-shells." Sweet almonds are highly valued as a food, as they contain a large amount of nutriment. They are eaten raw or "blanched" and are also much used in cakes and candies.

Almonds are grown extensively in western Asia, in the Mediterranean countries of Europe, and in California. Even where, owing to climatic conditions, the almond does not

bear fruit, it is often planted for ornamental purposes. The dwarf almond, which is a native of Russia, is much used for this purpose. Scientific name of almond, *Amygdalus communis*.

ALPACA. If you should climb 16,000 dizzy feet above the sea to the lofty tablelands of Chile or Peru, where some majestic peak of the Andes—

Giant of the Western Star,
Looks from his throne of clouds
O'er half the world—

you would find few other living creatures to share the solitude with you. But look! Do you see those gray and tan mice over there against the background of giant cliffs? As they come nearer they turn into woolly sheep-like animals the size of deer, and it almost takes your breath away to watch them scamper sure-footedly over boulders, up steep crags, and along yawning gorges.

These are the alpacas, semi-domesticated animals related to the camel and the llama, millions of pounds of whose strong silky elastic wool, clipped every year or two by the native Indians, are shipped to Europe and America. His long warm coat—sometimes two feet long—enables the hardy alpaca to endure the snow storms and icy winds of his lofty home. He is extremely active and alert to dangers, and Nature helps him to overcome many difficulties. His cushioned feet with their hard curved toe-nails help him to climb steep crags with safety; his long flexible camel-like neck and pointed muzzle enable him to reach herbage growing on high ledges; and his strong teeth help him to chew the tough leaves and stalks; while his queerly constructed stomach with its reservoir for fluids makes it possible for him to endure hunger and thirst for considerable periods. All this fits him to thrive in an altitude that would make us ill.

The *vicuña* is a wild variety of the same group, smaller than the llama but larger than the alpaca. It is trapped in herds on mountain heights by the Indians for its wool, which is one of the lightest and warmest known.

Genuine alpaca cloth is very firm, strong, and lustrous, closely resembling mohair. Most of the cloth sold under the name of alpaca, however, contains little or no alpaca wool, being a mixture of cotton and wool with a hard shining surface. Most of the so-called vicuña goods is a very soft fabric of wool and cotton. Scientific name of alpaca, *Lama pacos*; of vicuña, *Lama vicunia*.

ALPHABET. Of course you know your A B C's or you could not be reading this. But do you know

their wonderful history? Do you know that A was once the picture of an eagle, and B of a crane (some say a house)? That N was the water's waves and D a hand? That R was a man's mouth and O his eye?

Do you know, moreover, why it is that so many people can read in lands where English, French, or German is spoken and so few in China? Indeed, it is not because European peoples prize education more highly than do the Chinese, for nowhere in the world is a scholar more honored than in that mysterious land. The reason is that a Chinese must know about 3,000 different signs to read even an ordinary Chinese book, and really learned Chinese must know over 40,000. Every *thing* or *idea* in

Chinese writing has its separate sign. In Europe and America, on the other hand, we need to learn only the 26 letters or so that make up our alphabets. This great advantage of the alphabet arises from the fact that its letters now represent certain *sounds*, instead of things, by combining which we form syllables and words.

First of All Alphabets

Alphabetic writing was developed from *syllabic* writing, which in turn grew out of *ideographic* or *picture* writing, such as the Chinese still use (see Writing). The Egyptians apparently were the first to invent an alphabet, about the year 3000 B.C., although it never displaced their hieroglyphic (ideographic) writing. The ancient Aegean people of the island of Crete also possessed an alphabet at an early date. But it was the Phoenician traders of Tyre and Sidon first, and the Aramaean merchants of Damascus later, who spread

the knowledge of alphabetic writing east and west, in Europe and in Asia. Today the use of alphabetic writing is general throughout the whole world outside of China.

Altogether there have been some 400 different alphabets since the days of the Phoenicians; and at the present time there are about 50, not counting slight variations due to dialects. None of these alphabets is perfect. "The ideal alphabet," as one authority puts it, "would indicate one sound by one symbol, and not more than one sound by the same symbol." As all our English vowels have several sounds, some of our consonants two sounds that are duplicated by other letters, and a few have the sound values of diphthongs, the English alphabet falls short of this ideal.

A MOUNTAIN COUSIN OF THE CAMEL



Here you see the Alpaca, in his long woolly coat that protects him so well against the snow storms and icy winds of his lofty home. You can see, too, how handy that neck of his must be in reaching food on the top shelves of his "pantry,"—the rocky ledges of the mountains.

All the alphabets of Europe were derived, either directly or through the Latin, from the Greek, which in turn had its source in the Phoenician. The Phoenician alphabet had 21 or 22 letters, representing consonant sounds. The vowels *a*, *e*, *i*, and *o* were present, but were used as "aspirates" similar to our *h*. Centuries were required to bring this imperfect alphabet up to the requirements of the classic period of Greek literature. The aspirates were converted into true vowels, superfluous sounds were dropped, and *q* and *x* replaced diphthong combinations. In its final form the Greek alphabet of Athens had 24 letters.

How We Got Our Alphabet

The Latin or Roman alphabet, which came into use in Italy about the 6th or 5th century B.C., became the medium for the classical literature of Rome. The oldest Roman inscriptions show the original Greek letters in simplified forms. Some of the Greek letters are entirely omitted, so that the Latin alphabet consisted of only 21 letters. The five additional letters of our English alphabet arose from the introduction of *z*, the differentiation of *i* and *j*, and the expansion of *u* into *v*, *w*, and *y*. The German alphabet also comes from the Latin, but the letters retain the queer Gothic shapes of the Middle Ages.

The Russian alphabet, which today has 35 characters, was derived indirectly from the Greek, through the ancient "Cyrillic" alphabet, invented by Cyril in the 9th century A.D. in order to translate the Gospels into the language of the Slavs of Bulgaria and Moravia. There are also separate alphabets for Hebrew, Arabic, Turkish, Sanskrit, etc.

As trade and travel bring the nations of the earth into closer relations, there is a growing tendency everywhere to adopt the Roman alphabet. The Japanese have begun to use it for commercial purposes, although their literature is still written in Chinese characters, and China itself has taken some

steps to abandon its ancient system and adopt alphabetic writing.

ALPS. Nowhere else in the world are high mountain ranges so thickly populated as the Alps. Other ranges lift their eternal peaks in a solitude little troubled by man. But in the Alps men cluster in the valleys, and their tiny chalets with wide-projecting eaves, like doll-houses, cling to the steep slopes.

The Alps are quite different in appearance from any mountains in America. The Alleghenies are wooded or grass-covered knobs and ridges and the Rockies and Sierras are bare and bold, standing out in sharp relief in the crystal air. The Alps with towering snow-clad peaks are often covered and swathed in veils and bands of soft mist that shift and change color in the changing light. Only rarely do the peaks emerge, visible in their entirety. This means that the rain and snowfall in the Alps are much heavier than in our western mountains. Indeed the Alps are a great reservoir from which four great river systems—the Rhine, the Rhone, the Danube, and the Po—are fed perpetually, even in the driest season.

On the high peaks more snow falls each year than is melted on the spot; and this snow accumulates in valleys and is gradually formed into ice, which descends the slopes of the mountains in the form of glaciers and feeds these rivers. There are more than 1,000 of these glaci-

ers, most of them very small. Few of them are as much as three miles long and the great majority are less than one. One of the largest and perhaps the most beautiful is the Mer de Glace ("Sea of Ice"), on the northern slope of Mont Blanc. The countless waterfalls on the lower levels supply practically unlimited water-power.

The Alps cover an area about as large as Illinois and Indiana put together. The republic of Switzerland includes the center of the Alps, but they thrust their spurs and sentinel peaks into France, Italy, Austria,

WHERE WE GOT OUR A B C'S

Values.	EGYPTIAN.		SEMITIC.	LATER EQUIVALENTS.			
	Hieroglyphic.	Hieratic.		Phœnician.	Greek.	Roman.	Hebrew.
<i>a</i>	eagle				A	A	א
<i>b</i>	crane				B	B	ב
<i>k (g)</i>	throne		 		Γ	C	כ
<i>t (d)</i>	hand		 		Δ	D	ד
<i>h</i>	meander		 		E	E	ה
<i>f</i>	cerastes				Υ	F	פ
<i>z</i>	duck				Ι	Z	ז
<i>x (kh)</i>	sieve		 		H	H	ח
<i>θ (th)</i>	tongs				Θ	...	ט
<i>i</i>	parallels				I	I	י
<i>k</i>	bowl		 		K	K	כ
<i>l</i>	lioness		 		Λ	L	ל
<i>m</i>	owl				M	M	מ
<i>n</i>	water		 		N	N	נ
<i>s</i>	chairback		 		Ξ	X	ס
<i>α</i>			 		O	O	ע
<i>p</i>	shutter		 		Π	P	פ
<i>t' (ts)</i>	snake				...	...	צ
<i>q</i>	angle		 		...	Q	ק
<i>r</i>	mouth				P	R	ר
<i>s (sh)</i>	inundated garden				Σ	S	ש
<i>t</i>	lasso		 		T	T	ת

This table shows plainly how we got our A B C's from the Egyptians, by way of the Phoenicians, the Greeks, and the Romans. "A," for example, was first the picture of an eagle (or ibis). Then this picture became simplified, step by step, until finally it took the form in which we have it.

and Germany. The higher peaks, of which there are a large number, rise out of a series of lower chains and foothills to great heights—Mont Blanc, the “monarch of mountains” as Lord Byron calls it, being

THE EIGER, MOENCH, AND JUNGFRAU



These three noble peaks, all over 13,000 feet, present one of the most famous views in the Bernese Oberland. Far to the right in the picture is the Jungfrau, which gets its name (meaning “maiden”) from its virgin purity, enswathed in a dazzling mantle of eternal snow.

15,782 feet high. On the Italian side the mass of the Alps falls steeply into the Italian plain. On the other sides the descent is more gentle.

Why the Alps are Easy to Cross

Although the peaks of the Alps are much crowded, no other so lofty mountains are so easily crossed. Winding roads lead up through deep-cut valleys to many passes (Mont Cenis, Great St. Bernard, St. Gotthard, Brenner, etc.). The Romans knew a number of the passes well and often made use of them. Through the passes the northern barbarians descended on the Roman Empire from the forests of Germany, and through them Hannibal and Napoleon led their conquering armies. Today the St. Gotthard, Simplon, Mont Cenis, and other passes have been pierced by railway tunnels.

The Alps, particularly the Swiss Alps and the Austrian Tyrol, have an irresistible attraction for tourists from all over the world. Now that travel has been made easy many thousands of people each year go to Lucerne, to Interlaken—where the Jungfrau (“Maiden”) Mountain pierces the clouds in virgin purity—to Chamonix, below Mont Blanc, and to dozens of other beautiful places. And each year athletic travelers, with alpenstocks, ropes, and native guides, make the difficult ascent of the Matterhorn and other famous peaks. Many pleasure resorts with enormous hotels have been built, especially near the quiet gemlike lakes, rimmed by mountain and forest. Lakes Geneva, Lucerne, Como, Garda, and Maggiore are famous for their beauty, and many smaller lakes nestle in the valleys. For tourists who prefer to motor over the passes instead of going by train, carriage roads that are marvels of engineering have been blasted out of the rock, stone bridges thrown across torrents, and long walls constructed

to stop avalanches and guard precipices. High on the slope at the Great St. Bernard Pass, the monks of St. Bernard live in their centuries-old monastery. During every storm their bells peal out, and their big heroic dogs go forth to rescue travelers lost in the snow. (See Switzerland.)

The Alps are usually divided by geographers into seven divisions, the Maritime, the Cottian, the Graian, the Pennine, the Lepontine, the Rhaetian, and the Noric Alps. They contain relatively few minerals of commercial value.

ALSACE-LORRAINE (*äl-sās-lö-rān'*), FRANCE. This land, which is so often spoken of as a single territory, is in reality composed of two regions quite

THE MATTERHORN



Though the lordly Matterhorn is not the highest peak of the Alps (14,782 feet), its imposing shape and bold outline make it one of the most awe-inspiring. So steep are its rocky sides in many places that snow never finds lodgment. Only three of the party of seven that first scaled its summit in 1865 survived; four fell thousands of feet down a precipice.

distinct in geography and history. Northeastern Lorraine is a part of the old province of Lorraine, two-thirds of which remained in French hands after the Franco-Prussian War. It is separated from Alsace by the Vosges Mountains.

Alsace, after a stormy history marked by many medieval wars, became definitely a part of France in the 17th century during the reign of Louis XIV. Lying in the trough of the River Rhine, between the steep scarp of the Vosges Mountains to the west and the Black Forest to the east, its plain forms a natural

highway between France and Germany. It is generally a fertile land, and rich in timber. Its oil field at Pechelbronn—discovered in the course of the World War—and its potash deposits west of Mülhausen are of great economic importance. Although the language of the people in the country districts is a dialect of German, their sentiments have been French since the days of Napoleon.

Lorraine has been French in language and in spirit since the 12th century. The province extends from the Vosges to Champagne. The part seized by Germany included the chief city of Metz, which was strongly fortified, and enough of the territory to the west to protect this military position. In this territory lay a large part of the rich iron ore deposits of Briey between Metz and Longwy. These and the coal deposits in the Saar valley form the chief wealth of this region. Cereal crops, however, grow in abundance and many manufactories flourish.

Every effort was made during the period of German

rule to stamp out the French language and French sentiment, but without avail. When the World War broke out in 1914, many Alsatians and Lorrainers enlisted in the French armies, although they knew that if they were captured they would be shot as traitors by the Germans. When the United States entered the war, it was with the distinct understanding that among the things for which it fought was, as President Wilson said, to "right the wrong done by Prussia in 1871 in the matter of Alsace-Lorraine." (See map in article on France.)

The city of Strasbourg contains a cathedral which is a fine example of Gothic architecture. Built in the 13th and 14th centuries, it rises high above the clustered mass of peaked roofs which forms the older part of the town; it contains a famous clock, 30 feet high, with many automatic figures which move at certain hours and days. The important university of Strasbourg was founded in 1567. Lying as it does on the main roads of travel between France, Germany, and Switzerland, Strasbourg has been of military and commercial importance ever since Roman legions made it their headquarters. Population, about 180,000.

How the Tricolor Came Back to Metz



IN an ancient house on a crooked street near the famous "French gate" of the fortress city of Metz in Lorraine, an old white-haired man rose before dawn on the morning of November 19, 1918, and mounted to his attic by candle light. From a dark corner under the steep slope of the eaves, he dragged out a carefully wrapped package, thick with dust. As he opened it with trembling fingers, he started to hum a soldier's song of long ago.



Out of the package came strange garments—a long dark-blue coat, a heavy loose pair of red trousers, old worn boots, and a wrinkled cap with a flat red crown and a square straight visor. The old man slipped on this odd costume, and, as he straightened up painfully in a vain effort to stretch the seams, he smiled, for a long-forgotten gesture had come back to him. Instinctively the fingers of his right hand had closed over the edge of the sleeve,

and with the frayed blue cuff he was polishing one by one the double row of brass buttons on his thin chest.

But daylight had come, and he must hurry. Down the creaking stair he went to a small room where a boy was sleeping. He shook him by the shoulder.

"My boy, this is the day. Get up."

The boy rubbed his eyes and stared sleepily at the strange figure.

"You haven't forgotten the song, have you, my boy?" asked the old man.

"No, grandfather. Shall I sing it now?"

"No, I will tell you when to sing. But hurry now. You must come with me."

It was a cold cloudy day as the long column of soldiers in gray-blue uniforms marched up the west road leading through the "French gate" into Metz. At their head rode the great General Philippe Pétain who had just learned that he was to be made that day a Marshal of France for his celebrated victories in the World War. Eight days before, the Germans, driven back by the hammering blows of French, Americans, and British, had waved the white flag of surrender, and this was the vanguard of France, come to take back the old provinces of Alsace and Lorraine.

Drums were beating and banners were waving as the soldiers swung through the big gate. Men in the crowd shouted "Vive la France!" and women cried in joy at the sight of the tricolored flag, which had been seen there for the last time in 1871, when the Germans took possession after the disastrous close of the Franco-Prussian War.

But a young gray-blue officer noticed on the edge of the throng an old man in an ancient uniform standing silently at salute. And by his side a little boy, whose tiny voice was almost lost in the crowd, was singing over and over again 'La Marseillaise'. The young officer stiffened to attention and returned the salute.

"You are an old soldier?" he asked.

"I was with Bazaine in '70, my captain," replied the old man.

"And since then?"

The old man pulled a tattered sheet of paper from his pocket and handed it to the young officer, who read in the faded writing the famous declaration made in 1871 by the representatives of Alsace and northeastern Lorraine, when they learned their na-



tive land had been ceded to Germany: "We hereby proclaim the inviolable right of Alsatians and Lorrainers to remain members of the French nation, and we swear and make oath, for ourselves, our children, and our children's children, to vindicate that right eternally, by every means and against every usurper."

The old man pointed to the boy who was still singing the song of France. "That is my grandson—a true Frenchman," he said. "My son—he was with you at Verdun. He cannot be here now."

THE TRICOLOR ONCE MORE!



Here we see the French soldiers taking possession of a town in Alsace at the close of the World War in 1918. Every house is gay with garlands and bunting, and the French tricolored flag, banished since 1871, is flying everywhere. One house, you notice, is also flying the flags of the United States and Great Britain.

"But you, and this uniform?" inquired the young officer gently.

"I?" said the old man proudly. "I, my captain, have been holding Metz for France for 47 years."

It was a week later that General Gouraud entered the city of Strasbourg, capital of what had recently been the German province of Alsace-Lorraine, and

officially took over again for France all the land lost in '71. Many soldiers whose fathers had lived in the "lost provinces" were in Gouraud's army. Cheers and tears of joy greeted their homecoming.

ALUM. Touch a piece of alum to your lips and it puckers your mouth. This is because it is an astringent, which means a substance that binds or contracts the tissues. It is this property which gives alum its value in medicine and the arts, and likewise its injurious effects when taken internally in any considerable quantity.

Alum is what is known in chemistry as a *double salt*, the two salts which compose it being usually sulphate of aluminum and sulphate of potassium or of ammonium. It forms in colorless eight-sided crystals, which contain much water. If it is heated sufficiently the water will boil out, leaving a powdery mass known as *burnt alum*.

Among the simpler uses of alum in medicine may be mentioned its application to stop bleeding and as a remedy for canker sores. One of its important industrial uses is as a *mordant*, or "fixing" substance in dyeing. The cloth is wet with a solution of alum, which bites into the cloth and makes the dye "fast."

Mixed in milk, alum helps in the separation of butter. Bakers formerly used it to whiten their bread, and it is used quite extensively in the manufacture of baking powder (see Baking Powder). Housewives sometimes use it in canning to preserve the shape and color of the fruit. If added in small quantities to turbid water, it will in a few minutes make the water perfectly clear. Thus it is sometimes used, either with or without lime, in filtering and settling tanks in city waterworks.

Alum is found to some extent in a natural state, but most of it is manufactured. It is obtained from *alum-stone* or *alunite* by a process of roasting. In the Middle Ages the alum used in Europe came from lands in Asia held by the Mohammedans. But in the 15th century valuable mines of alum stone were discovered at Tolfa, in a district in southern Italy ruled by the pope.

ALU'MINUM. The most abundant of all the metallic elements in the earth's surface is aluminum, and among all substances it is only exceeded in abundance by oxygen and silicon. Yet until 20 years or so ago nobody had ever seen a piece of the aluminum kitchenware which is now so common, and few knew that there was such a metal.

The reason is that aluminum is never found in a native state, but always combined with other elements. Granite, felspar, mica, and clay contain much aluminum; garnets are a silicate of calcium and aluminum; turquoises contain it; and alums, which derive their name from this metal, are mostly salts of it. But the chief commercial source of aluminum is a mineral called *bauxite* (pronounced *bōz' īt*, from Baux, France). Most of the bauxite mined in the United States comes from Arkansas, Alabama, and Georgia.

This silvery satiny metal is exceedingly light in weight, yet in hardness and tensile strength it is equal to any metal except steel. It can be drawn into wires as fine as those of copper and can be hammered into foil like gold-leaf. Like lead it is easily molded, leaving the molds with a glass-like surface which tarnishes very slightly. It is non-magnetic and hence is very useful in electrical work.

Aluminum, however, is difficult to "machine" because it sticks to the tools, but an alloy with magnesium (called "magnalium") has easy working qualities. Copper-aluminum bronze, containing 5 to 12 per cent of aluminum, is easily fusible. An alloy, called "duralumin," consisting of 96 parts aluminum, three parts copper, and one part magnesium, was extensively used in the World War for making shells, helmets, grenades, and camp equipment. Pure aluminum is also used, on account of its strength

and lightness, for airplane and automobile parts. The difficulty of welding or soldering aluminum, which formerly limited its use, has now been overcome.

The great affinity of aluminum for oxygen makes it useful for producing extraordinarily high temperatures. When a mixture (called *thermit*) of powdered aluminum and iron oxide is ignited, the aluminum and oxygen unite with such vigor and rapidity that tremendous heat is produced—about 3,000 degrees Centigrade (5,432 Fahrenheit). The iron is instantly fused into a molten mass, which may be used for welding rails, shafts, and broken pieces of heavy machinery. Pure specimens of such metals as chromium, uranium, and manganese, whose oxides are otherwise hard to reduce, may be obtained in a similar way.

Aluminum has many other important uses. The powdered metal, mixed with oil, makes a silvery aluminum paint; mixed with ammonium nitrate it makes the explosive ammonal, which was extensively used in the World War. The largest part of the aluminum of commerce is used by steel makers; a small amount added to molten steel combines with the gases and so gives ingots free from blow holes.

Aluminum is prepared on a large scale at Niagara Falls by electrolysis. This process, first applied in 1886, lowered the price from \$4 a pound to 18 cents within the lifetime of the inventor. The United States produces as much as all the rest of the world put together.

AM'AZON RIVER. "Water! Send us drinking water!" was the despairing signal which a becalmed sailing vessel once made to a passing steamer, some 50 miles off the northeastern coast of South America. "Dip it up from the ocean; it is all about you," was the strange but true message signalled back. So vast is the volume of fresh water discharged by the mighty Amazon River that it is noticeable—and even drinkable, if we may believe the stories—100 miles from shore.

The Amazon, indeed, is not so much a river as a gigantic water reservoir, extending in the rainy season from the sea to the base of the Andes, and varying in width from 5 to 400 miles. It is thus the largest river on the globe, and if it is not the longest also it is still very long. The Marañon, as its upper course is known, rises in the Andes of Peru, within 60 miles of the Pacific Ocean. The mouths of the Amazon empty into the Atlantic, just at the Equator. Its extreme length from source to mouth is about 4,000 miles.

The width of the main stream at its mouth is 60 miles, and the tides travel up it 400 miles. Two thousand miles from the sea it still has a width of more than a mile, and the depth for 750 miles is nowhere less than 175 feet.

The Amazon with its branches is navigable for small steamboats for 16,000 miles. Over 200 branches and lesser tributaries form the main trunk, one of the tributaries from the south being named Rio Teodoro (Theodore River), in honor of President Roosevelt who explored it. The drainage area includes about one-third of South America. There is scarcely a perceptible fall in the river from the Andes to the mouth, and there is good reason for thinking that the whole region was once a vast gulf, now filled by the rising of the land and the silt carried down by the river's current.

A Vast Green Wilderness

The greater part of this great basin is a "sea of verdure," extending as a traveler says "in an unbroken evergreen circle of 1,100 miles' diameter." The extensive forests are truly tropical, being so dark and thick, so twisted and matted and interlaced with trees, vines, and shrubs, as to present an almost impassable barrier. There are probably not 25 square miles cleared and under cultivation, except in the almost inaccessible mountain regions of its source. A few hundred thousand scattered Indians, engaged in hunting, raising cacao, and collecting rubber and Brazil nuts, make up the greater part of the population of an area equal to five-sixths of the whole United States.

In all this vast area there is scarcely a mile of railroad and practically no roads. Travel is entirely by water, and very largely in the long black native canoes, which the Indians pole up stream in the shallow water at the river's edge or through the innumerable bayous and swampy channels which parallel and intersect the main stream. On the banks of reddish clay we see broad-leaved magnolias, trees with thin needle-like foliage, and live oaks and water oaks whose trailing silvery moss drags in the river's current. In sheltered coves and lagoons



The immense basin of the Amazon and its tributaries is nearly as large as all the United States, as the circles in the right-hand corner of the illustration show. This rich and fertile region, embracing northern Brazil and parts of Peru, Bolivia, Colombia, and Venezuela, is one of the largest undeveloped areas remaining on the globe.

grow innumerable pond lilies, one species of which has leaves turned up all around the edge and measuring three to five feet across. The air is

laden with the perfume of a small yellow flower called the jasmine, which is poisonous to the touch; and everywhere clambers the cypress vine with its dainty slender leaves and starlike blossoms.

Alligators, Monkeys, and Birds

On sunlit slopes along the banks great lazy alligators sleep; and at the slightest unusual sound hundreds of timid forest creatures scamper noisily away through the dense undergrowth. The monkeys are endless in number—small, gray, long-tailed creatures who chatter angrily in the tree-tops, seemingly unafraid, but who disappear as if by magic at the first attempt to capture them. Birds are few, and these of brilliant colors, but harsh and repellent voices.

Here and there are the few little villages, built of mud and logs in clearings on the steep banks, or on piles driven into the river's bed. Even the plantation owners usually build their houses in this manner over the river, as a means of escaping the dreadful insects and mosquitoes which swarm in the forest. One scarcely ever sees a domestic cat or dog, and horses and cows are practically unknown. (See Brazil.)

AMAZONS. Of all the mighty hosts described as fighting in the siege of Troy, the Amazons were the strangest. They were a mythical nation of female warriors, ruled alike in peace and war entirely by women. It was said that their country bordered on the Black Sea, and that no man might dwell therein. Even the boy babies were sent to their fathers, who dwelt outside the borders. The girl babies were kept and brought up by their mothers, and trained to agriculture, hunting, and the art of war. The arms of the Amazons were the bow, spear, ax, and a shield shaped like a crescent. Usually they fought on horseback and they were most formidable warriors. Greek legends tell of adventures of Hercules and Theseus in the land of the Amazons; and it was said that Achilles slew their queen in a fierce battle under the walls of Troy. Many Greek works of art portrayed these female warriors, along with the centaurs.

In out-of-the-way places on the globe geographers have found strange peoples among whom the rights of the mother are stronger than the rights of the father, and where women have an importance and perform many duties which elsewhere belong to men. It is

thought that the Greek stories of the Amazons arose from such travelers' tales.

History records many instances of women warriors. In modern times the King of Dahomey, in western Africa, had an army of women; and in the Russian Revolution of 1917 there was a women's "Battalion of Death," vowed to fight to the last breath in defense of Russia. The Amazon River, in South America, received its name from the fact that one of the earlier explorers was there attacked by a tribe of savages, among whom the women fought alongside the men.

AMBER. Countless ages ago clear pitch or resin exuded from pine trees, and accumulations of it were covered up by various layers of soil. In the course of time these buried resins became hardened and changed somewhat in substance, becoming amber.

Amber is a brittle yellow translucent substance, hard enough to be cut into beads and ornaments, but not hard as compared with marble or glass. The ancient Phoenicians, Greeks, and Romans valued amber highly, and attributed mysterious powers to it, because it becomes electrified when it is rubbed and attracts light bodies. The Greeks called it *elektron*, from which we get our word electricity. Occasionally insects of species now extinct are found entombed in the lumps.

The variety of pine which produced amber grew chiefly on the site now occupied by the Baltic Sea and the North Sea. This

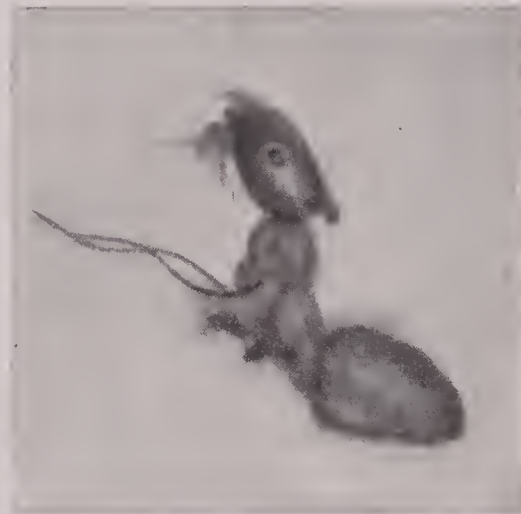
part of the earth's crust gradually became submerged. When these waters are disturbed by violent storms, pieces of amber are frequently washed out and cast up on the neighboring shores. The ancients got all their amber by picking up these fragments, but today most of it is obtained by mining.

Amber is usually found in small pieces, but some lumps weighing up to 15 and 18 pounds have been found. Small quantities are found in Great Britain, Sicily, Siberia, Greenland, and the United States, but the chief source is along the shores of the Baltic, especially in East Prussia.

Amber is used chiefly for the mouthpieces of pipes, and for ornaments. In recent years its place has largely been taken in these uses by an artificial product of carboic acid and formaldehyde called "bakelite" (see Celluloid).



Here, much enlarged, is one of the ancient insects found in amber. It is related to the Hessian flies of today that get into the farmer's wheat. You can even see the impression of its two delicate wings.



This is an amber-entombed ant of those distant days when amber was still soft pitch.

LITTLE TALKS ON GREAT THINGS by *Arthur Mee*

AMBITION

WE ARE living at a time when to be young is the proudest thing in the world. There is hardly a successful man living who would not give his success for the years that lie before you. A famous man once said he would give all he ever had to be alive in 50 years.

The world will be a fine place to live in when you grow up. What are you going to do in it? Are you going to muddle through somehow until the dark gates open that lead into another life, or are you going to make yourself known and felt and become a power for good? You live in a small town, perhaps, and have not seen much of the great world beyond; but every avenue that leads to fame in this great country begins at the door of your school. You may walk out of your school and be president of the United States, or the mistress of the White House.

The Prizes are for Those who Seek Them

Nothing can keep you back if you mean to go forward. The roads that lead to success are widening more and more. You may wander in a hundred fields and pick your prize.

As you sit reading this, thinking perhaps of all the difficulties you have and thinking that there can never be anything but a struggling life before you, you may feel that this is all very well for others, but that somehow it is not true for you.

If you think like that you may make up your mind at once that it is *not* true for you, for none of us can get any farther than we look. We must make up our minds where we are going. Remember that it is not the way you go that matters most, but *how far you go* that way; whether, when you have chosen your way, you acquit yourselves like men. Remember that all useful work is honorable, and that the only dishonor in it is if it is badly done. And the task that is set before everyone is, not to be this, or that, or the other—to mind a machine, to drive a plow, to write a book, to paint a picture, or go to Congress; the great task set before us is so to prepare in the days of our youth that in carrying on our work in the world we shall do things well.

What, then, are the qualities we need

most on our way through the world? There are not many things that all men agree on, but some things there are that everyone knows to be true; and, perhaps, the first of these things is that *to do anything worth doing we must have a definite purpose*. We must have an aim in life. We must make up our mind what we want to do, how we want to do it, and must let nothing come in our way.

We must believe in ourselves and in the purpose we set before us. Do not believe those who would tell you there is anything wrong in the desire to get on. There is a right getting-on and a wrong getting-on, and when we say that we want to get on, I hope we always mean not merely that we want more money in our pocket but that we want to *know* more as well as to *have* more; that we want more opportunities of well-doing and well-being. There are low ambitions and high ambitions. Let us see that we aim at a high purpose. In Emerson's splendid words, let us "hitch our wagon to a star."

You are right to be ambitious to succeed; you are right to seize every opportunity that will help you on the road to prosperity. A country is rightly proud of its prosperous citizens and we owe it to our country to build up its material and moral greatness.

There are two classes of people in every country—those who keep its honor bright and those who spoil its name. You may belong to either. It does not matter who you are, whether you are rich or poor.

Sure Recipes for Failure and Success

If you want to fail in your life, to disappoint yourself and those who love you, to give your country nothing back for all it has given to you, you need not greatly trouble. Thousands of men in poorhouses and prisons can give you a recipe for failure. Here is such a recipe:

A careless school life. Wasted evenings. Bad reading. An insatiable desire for sport or amusement. Living from 15 to 20 without a definite idea of what you are going to do with your life.

That is a recipe for a useless life which has never been known to fail. If you want to succeed in your life, to make your father and

mother proud, to have your comrades proud in years to come that they were at school with you, to make your country's reputation higher still throughout the world, you can make your success sure now. Thousands of men in high positions can give you a recipe for success. Here is one:

A well-spent youth. Healthy amusements. Evenings of recreation and study. Good reading and companions. A definite idea of what you mean to be, and a belief that you will be what you make yourself.

You cannot have all the books you want; you cannot stay at school, perhaps, as long as you should. But you can have knowledge, the most interesting and powerful thing in the world; and with knowledge hardly anything is impossible to a boy who means to get on. Nothing is so winning as knowledge and enthusiasm hand in hand. "As you think, so you are," says the man of science. As you are in boyhood, so will your manhood be.

Why, then, if our success depends upon ourselves, do so many fail? Well, there are many kinds of failures. A few—very few—fail through circumstances beyond their control; some fail through lack of concentration, through being unable to fit themselves to circumstances, or to look forward; others fail through sluggishness, indifference, or bad character. But in nearly all cases failure may be traced to one thing—to boys or girls shutting their eyes to their opportunities.

Make Up Your Mind, Then Go Ahead

You can be what you make up your mind to be, if you make up your mind that it depends on you. Be resolved and determined to reach your end.

We must be resolute; we must have determination; we must concentrate on realizing the height of our ambition in all we undertake. It is no use our having ideas unless we mean to carry them out. It would take a week to tell you of half the things that men have said to be impossible which have been done by men of determination. Men said it was impossible to have railways, and the man who first tried to make a steamship was driven to despair by people who looked upon him as a man out of his mind. Even Sir Walter Scott said that a man was an idiot to talk of lighting London by gas. The men who gave us the inventions which make

millions happy and wealthy today were often ridiculed and driven to starvation, and we owe the pleasures we get from their inventions simply to their unwearying ambition and the determination which never gave way. Stick to your work and pursue it. Do not give yourself so many things to do that you can do none of them well. You are only wasting your time if you fritter it away in little things that amount to nothing.

The boy who sticks to his work—that is the boy the world is waiting for. That is the boy for whom somebody has \$10,000 a year. That is the boy who will paint the picture that everybody will go to see. That is the boy who will be manager of a big store. That is the boy that every mother wishes her son to be.

Be Proud of Your Country

You are growing up in the greatest country in the world. There are many things to put right—sad things and bad things that will cry aloud to you when you grow up. But that must always be, until the end of the world, and what I hope you are growing up to feel about your country is that it is the best of all countries that have ever been. You belong to the freest nation that has ever been known, and you are growing up to take your place in it. You will have to help to rule it. You speak a language which is covering the earth; you will grow to know how rich is the opportunity and how great is the glory of being born in a free land.

And it is for you—you who will rule America in a not far-off tomorrow—to keep its name untarnished. Be proud of your country, which has given you more than you can ever pay back.

Be bold and courageous. Do not be afraid if you make a mistake. One of the most successful men in the world once said to me: "Never be afraid of mistakes. I have made many of them, and am going to make more." It is perfectly true that the man who never made a mistake never made anything. Do right because it is right, and be bold in doing it.

Be in all things honorable; be capable in what you undertake; be afraid of nothing but evil; be anxious for nothing but good. So you will serve your country well; so you will honor God; so you will travel to your destiny with peace and love for your companions, by a way which no cloud can darken, with a calm which none of this world's sorrows can destroy.

AMERICA. For thousands of years before Columbus accidentally stumbled upon the New World, this great land mass lay to the west of Europe and Africa, unsuspected and unknown. True, there had been

vague rumors that land existed to the west. The legends of the lost Atlantis, of a mysterious land called Brazil, and of the Isle of St. Brandon, all probably grew out of some knowledge of this land. Moreover, some five hundred years before the time of Columbus, Leif Ericson and his hardy vikings of the North had actually visited the northeastern coasts of North

America. But the Northmen had failed to follow up their discoveries, and

not until centuries later did the story of their discovery of "Vinland" become generally known through studies of the old Norse sagas.

Even Columbus little realized that he had discovered a new world; when he died, the people of Europe still popularly believed that he had reached the islands off the coast of Asia, and for a long time it was by the name of "Indies" that Spanish documents referred to the land to the west.

This ignorance of Columbus is not surprising since he touched only a few places in the New World. The West Indies, the Bahamas, the coast of South America at the mouth of the Orinoco, and the coast of Central America were all that he opened up before the eyes of Europeans. From his brief visit to the mainland he gained no idea of the size of the land mass nor of its continuity, and North America was not even touched by him.

Gradually, however, bit by bit, the two continents emerged as from a mist before the world's astonished eyes. The English explorer Cabot and the Portuguese Corte-Real sailed along the coasts of Newfoundland and Labrador. Verrazano, sailing for the French, started at Newfoundland and went as far south as North Carolina. Ponce de Leon made known the peninsula of Florida; Pinzon and Cabral

visited the coast of Brazil; and Juan Diaz de Solis pushed southward to the banks of the Plata River. Meanwhile a letter by Americus Vespucius, describing voyages which he had made to the northeastern coast of South America, led to the giving his name by mistake to the whole New World (*see* Vespucius, Americus).

Three Hundred Years of Discovery

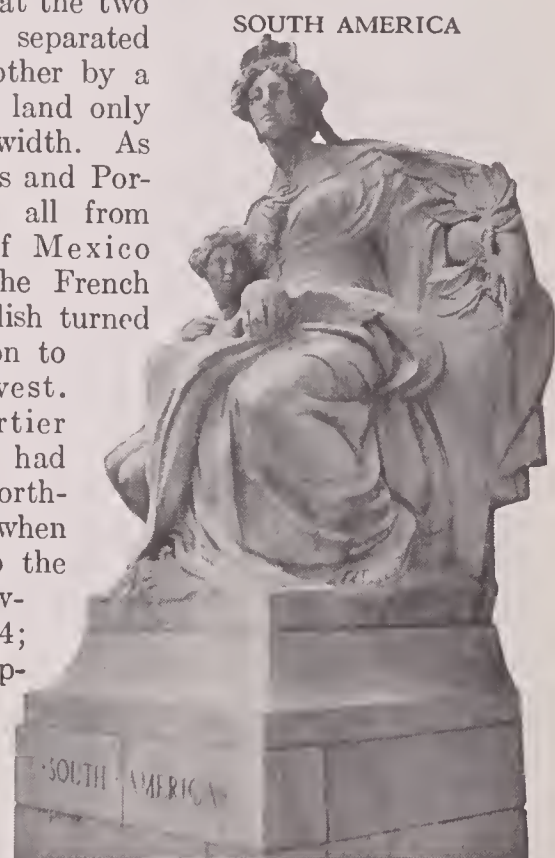
Still, Europeans had no true idea of the extent of America. This knowledge was gained by the conquests of Cortez in Mexico and Pizarro in Peru; by the explorations of De Soto and Coronado in southern and southwestern United States; and by the voyage of Magellan to the extremity of South America, through the straits that bear his name, and on to the Indies. The Englishman Drake continued the exploration of the western coast as far north as northern California; Bering and Vancouver completed the task by exploring the northwestern shores. Only after three centuries (1792) was the entire Atlantic and Pacific coast line of America made known.

In the meantime finding that America was not the opulent East, and that it was thrown like a barrier across the western way to the real Indies, men began the search for a passage through it. The idea that there was such a passage became almost a certainty when Balboa, in 1513, crossed the Isthmus of Panama and found that the two oceans were separated from each other by a mere neck of land only 50 miles in width. As the Spaniards and Portuguese held all from the Gulf of Mexico southward, the French and the English turned their attention to the Northwest. Jacques Cartier thought he had found this Northwest Passage when he sailed into the Gulf of St. Lawrence in 1534; but when Captain John Smith landed at Jamestown in 1607 the

passage was still undiscovered. Because any river might prove to be the longed-for route, Smith explored not only the Chesapeake, but all of the streams which flow into it.



In front of the Pan American building at Washington stand two noble groups of statuary, one representing North America, the other South America. North America, by Gutzon Borglum, is shown with the torch of civilization in her right hand, and beneath are the emblems of Art and Industry.



This is the companion group to that of North America, described above, and is by Isidore Konti. The Pan American building was erected in furtherance of closer relations between the United States and her sister republics, from a fund supplied by the joint contribution of Andrew Carnegie and the twenty-one American nations, including the United States, which form the Pan American Union.

MAP SHOWING ROUTES OF EXPLORERS



We say that Columbus "discovered" America in 1492; but, as a matter of fact, it took 300 years to discover merely the outline—the shape—of the Americas, and it took a great many bold navigators to do it. Indeed, as you can see by McClure's route, away up there in the icy seas of the North, it was not until the beginning of the latter half of the 19th century that the work was finally completed by the discovery of the famous Northwest Passage, which so many explorers had vainly struggled to find. First of all came Columbus in 1492; then his second voyage in 1493, and his third and last in 1498. Meanwhile, in 1497, John Cabot, sailing on behalf of England, was the first (except the Norsemen, whose names are not included among the explorers because we know next to nothing of the route they took or where they landed) to touch the continent of North America.

Henry Hudson was convinced that he had found the passage when he sailed up the river which bears his name, and when he was disillusioned he tried farther north at Hudson Bay. Not until 1850-53 did the British Arctic explorer Sir Robert McClure succeed in making his way from one ocean to the other by the Northwest Passage, and demonstrate the impossibility of commerce by this icy route.

The result of these patient explorations was the

emergence of a New World utterly unlike anything which Europeans had known before. Even in physical appearance it differed greatly from Europe. There the highlands are in the center of the land mass, with wide plains sloping towards the northern and western oceans. In both continents of the New World a lofty rugged mountain mass runs like a backbone through the western part, forming the Andes in South America and the Rockies in the northern

continent. Near the eastern coast of each continent there lies an older and less rugged mountain system—the Brazilian and Appalachian, respectively; and between the eastern and western highlands are vast central plains, through which flow mighty rivers.

It was the inhabitants of the New World, however, who most amazed the early explorers. Here they found a copper-colored race whom they called "Indians," but who proved quite unlike the natives of the real Indies in Asia. These Indians lived for the most part in tribes and their civilization was of various stages. There were the wandering tribes of the north, who lived by hunting and fishing and whose weapons were made of stone. Farther south were the cliff dwellers and the pueblo Indians. In Mexico and Peru the Aztecs and Incas had developed permanent dwellings grouped in cities, with many improvements in the way of irrigation and water supply. But even these people were far behind the civilizations of Europe and Asia. The American redmen had been separated by distances and impassable seas from the ancient seats of civilization—Egypt and Babylonia, Greece and Rome, India and China—from which had come the art and culture of the Old World. The New World, too, was seriously handicapped in developing a civilization of its own by the lack of any large

animals capable of domestication. The ox, the horse, and the ass were all lacking in the Western Hemisphere; the buffalo was incapable of taming by man, and the llama, the largest animal which could be domesticated and trained to bear burdens, was too weak and too slow to be of much value either in peace or war.

So because of their inferior culture, the aborigines of America were conquered and crowded out by European settlers. In time the whole of the two continents came under the sway of Old World nations. England eventually held the greater portion of North America, while Spain possessed Mexico, Central America, and all of South America except Brazil, which was in the hands of Portugal. But beginning in 1776, with the revolt of the Thirteen Colonies which founded the United States, the colonies began to break away from the Old World dominion. Today practically the only possessions held by European nations in either of the two continents are the Guianas on the northern coast of South America (divided between Great Britain, France, and Holland), and the Dominion of Canada; and the latter, although a part of the British Empire, is virtually self-governing. (See also Central America; North America; South America.)

AMERICAN AUTHORS *and What They Wrote*

AMERICAN LITERATURE. Writers of literary history remind us that America's literature is only an offshoot of English literature. That is true, for it is written in the English language and is rooted in the religion, folklore, and literature that is the common heritage of both countries. But it is also true that American literature is a branch transplanted to a new soil and developing under new influences, so that it has come to have character distinctly its own.

The Beginnings in Colonial Days

To understand American literature one needs to go back of the years when it had its first distinctive beginnings, to colonial times. Naturally, neither Virginian adventurers nor New England Puritans wrote much—they were too busy clearing the forests, planting the soil, and fighting Indians. But they did keep records and write letters and pamphlets home to England, and the New Englanders developed a rather extensive religious literature.

The first colonial writer was that dashing soldier Captain John Smith, whose romantic 'True Relation of Virginia' was printed in England in 1608. In

"WHO reads an American book?" scoffingly asked Sydney Smith, an English wit, early in the 19th century. Today we could answer that everyone who cares about good reading knows about the works of Poe, Whitman, Henry James, Mark Twain, and a host of other American writers. But when the question was asked, literary America had no such famous names to offer. That same quarter of a century, however, brought to light the first great American authors. And since then, on through the golden time of Longfellow, Emerson, and Hawthorne, and the after-years with their multiplying novels, short stories, and verse, the number has steadily increased. This article will give you a glimpse of the pageant of American literature and its makers.

serious-minded New England, two governors who kept valuable historical records, "in a plain style and with singular regard to the simple truth in all things," were William Bradford and John Winthrop. The poetry consisted mainly of hymns and the Psalms done into queer rhyme. The 'Bay Psalm-Book' (1640), printed on

the new printing press set up at Cambridge, Mass., was the first book in English printed in America; in Mexico, however, the Spaniards had established printing many years before this. Another curious book was the 'New England Primer', whose *A B C* ends thus:

Z. Zaccheus he
Did climb a tree
Our Lord to see.

Two famous preacher-writers were Cotton Mather (died 1728), who wrote extensively on theology, New England history, and witchcraft, and Jonathan Edwards (died 1758), author of 'The Freedom of the Will'. A little later, *Poor Richard's Almanac*, published annually for 25 years by practical Benjamin Franklin, reached with its wise sayings into every home, and helped to develop industry and thrift.

Before, during, and just after the Revolution, any American who had a gift for writing put it to hasty but practical use. Pamphlets and speeches abounded, all filled with a growing spirit of citizenship and patriotism. John Adams, Patrick Henry, Richard Henry Lee, James Otis, Samuel Adams, and Josiah Quincy were stirring speakers, contributors to newspapers, and pamphlet writers. Thomas Jefferson drew up the 'Declaration of Independence', carried on a voluminous correspondence, and wrote many admirable state papers. Thomas Paine, who came from England in 1774, in his 'Common Sense' and 'The Crisis', fearlessly and in trenchant phrase set forth the true meaning of the struggle with the mother country. Alexander Hamilton, with John Jay and James Madison, wrote 'The Federalist'—a series of essays which formed the ablest defense and clearest exposition of the new Federal Constitution. Washington, with the aid of Hamilton, Madison, and other advisers, wrote his immortal 'Farewell Address'. All these men belong to history rather than to literature. Two autobiographies, however, have a place in literature. One is the diary of good John Woolman, a New Jersey Quaker; and the other, of far wider fame, is Franklin's 'Autobiography', which unquestionably ranks among the few great autobiographies ever written.

First Poetry and Fiction

Though the Revolutionary times were as unfavorable as possible for the beginning of anything like good poetry or fiction, nevertheless Philip Freneau composed, besides political satires, pieces like 'The Indian Burying Ground' that mark him as America's



BRYANT
Poet of Nature

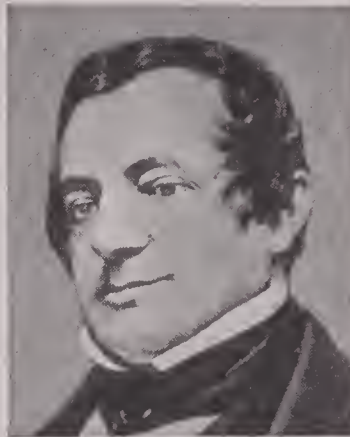
first true poet; and Charles Brockden Brown, the first novelist, wrote his 'Wieland' (1798) and other "tales of terror." In this connection may also be mentioned John Trumbull's 'McFingal', a satire on the American Loyalists or Tories, in which occur the lines:

No man e'er felt the halter draw
With good opinion of the law.

Once the wars with Great Britain were over, the

country could turn with renewed attention to developing its resources and developing a distinctly national civilization. The new settlers had built their house and settled their quarrels with their neighbors, and now they could, as it were, sit down and enjoy what they had, and plan how to make the new house bigger and more beautiful. The years from 1815 to 1837 have been called an "era of good feeling." The Mississippi valley was being settled, the nearer West

was opening up, and Americans felt a new dignity as a nation. Authors found both leisure and stimulus to write for the sake of writing. Presently four really great writers appeared whose work had a distinctly national flavor and won instant fame abroad.



IRVING
Father of American Prose

Washington Irving, "father of American literature," was the first, with his humorous 'Knickerbocker's History of New York' (1809) and his 'Sketch-Book' delightful in description and story, and skilful in his use of history and legend. Then came James Fenimore Cooper, who set up a broad New World stage of forest, plain, and sea for such thrilling novels as 'The Spy' (1821) and 'The Pilot', and created a new sort of American romance in 'The Last of the Mohicans' and others of his 'Leatherstocking Tales'.

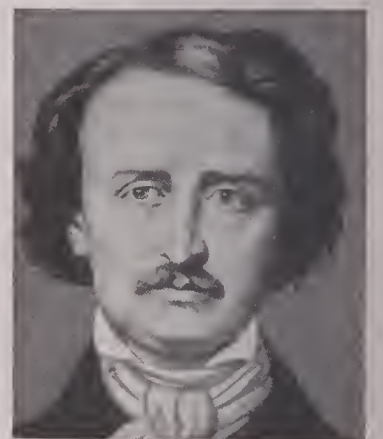
The breadth and sweep of nature in the New World inspired also America's first great poet, William Cullen Bryant, whose 'Thanatopsis' appeared in 1817, and through whose verses flow—

... feelings of calm power and mighty sweep,
Like currents journeying through the boundless deep.

Not much later appeared the work of Edgar Allan Poe, whom the French have called America's greatest genius—clever detective tales, thrilling mysteries, vivid horror tales, symbolic stories, all written with the beauty and wonderful word-music that his poetry possesses, whether it be the somber 'Raven', or 'Ulalume', or 'The Bells' that—

... tinkle, tinkle, tinkle
In the icy air of night,
While the stars that oversprinkle
All the heavens seem to twinkle
With a crystalline delight.

Alongside Bryant and Poe other poets of the time seem insignificant. But Joseph Rodman Drake's 'American Flag', Fitz-Greene Halleck's 'Marco Bozzaris', and John Howard Payne's 'Home, Sweet Home' are still remembered. Another name once famous but now almost forgotten is that of Nathaniel Willis, a graceful American poet and prose writer.



POE
Wizard of Word Music

From the War of 1812 to the Civil War, great national questions demanded discussion and settlement—states' rights, the tariff, internal improvements, what to do with new territories, the growing puzzle of slavery. This was the time of America's great orators: Henry Clay, John C. Calhoun, Daniel Webster, Wendell Phillips, Edward Everett. As the century grew older, the country opened out into a vast territory full of new opportunities. A bigger

national consciousness had developed, and time had given America a richer background of thought and experience. Over in Europe, also, many great changes and thought-movements were in progress, and there were many new thinkers and writers.

Golden Age of American Literature

All these influences were reflected in New World literature, and about 1840 began its great creative



EMERSON
Inspirer of Thought

period—that of the poets, essayists, and other writers who made the middle 19th century America's golden age of literature. Naturally enough it was New England, at that time America's foremost center of culture, that produced almost all of them.

These were men of fresh alert minds. They were artists whose words could paint pictures or make music; and they were also men who desired to use their knowledge and art to awaken Americans to thought on religion and philosophy, or on national and social questions like slavery, and to give them a wider knowledge of books and men.

The question of religion was again stirring New England. The church that the Pilgrim Fathers had founded for freedom of worship had become hard and narrow, and many were breaking away from it. This contributed to the change of religious views manifested in the Unitarian movement, and to the further broadening of thought that was called Transcendentalism. It would be hard to explain briefly the views of the transcendentalists, and some of their experiments, like the Brook Farm community life, were not very successful. But their aims were high, and the movement strongly influenced not only those directly connected with it but many other American writers and thinkers of that time.



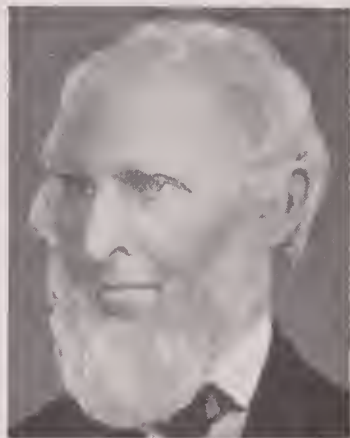
HOLMES
Witty Essayist and Poet

Henry Wadsworth Longfellow put his literary knowledge and his gift for making simple melodious verse

into writing the poetry that has made him the best loved of all American poets. Every school child knows 'Evangeline', and 'The Courtship of Miles Standish', or at least has followed where—

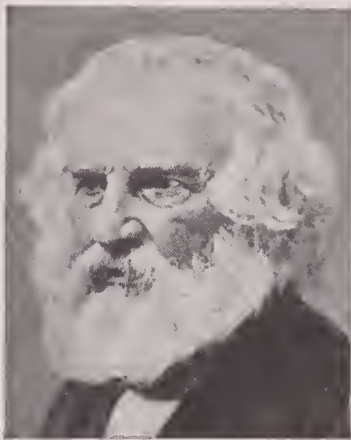
Forth into the forest straightway
All alone walked Hiawatha
Proudly with his bows and arrows;
And the birds sang around him, o'er him,
'Do not shoot us, Hiawatha!'

John Greenleaf Whittier wrote his calm Quaker hymns and his stirring war poems, and pictured the simple life on a New England farm, where he himself had been a "barefoot boy with cheek of tan." The busy charming physician Oliver Wendell Holmes, in his delightful 'Autocrat of the Breakfast Table', showed American readers the value of culture and entertained them



WHITTIER
The Quaker Poet

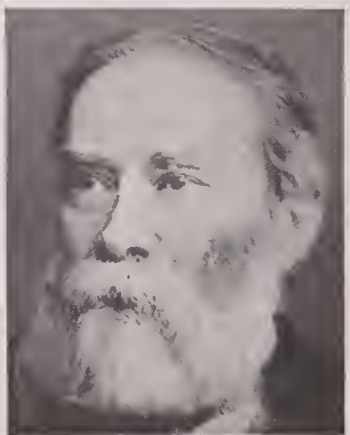
with wise thought and clever fun. James Russell Lowell, author of 'The Vision of Sir Launfal', 'Biglow Papers', 'The Crisis', and a host of other poems, was another ardent antislavery poet; he was a great critic, too, and his essays on books and reading have helped many to choose well their reading and to appreciate to the full its beauties. He has left the world many "immortal phrases" such as "Truth forever on the scaffold, Wrong forever on the throne"; "Who speaks truth stabs falsehood to the heart"; "New occasions teach new duties; Time makes ancient good uncouth; They must upward still and onward, Who would keep abreast of Truth."



LONGFELLOW
Laureate of Song

A very different sort of poet was Walt Whitman, the child of the New York metropolis. He wrote with entire freedom from the usual rhyme and rhythm, and with equal freedom of thought. His noblest poem is his tribute to Lincoln, 'My Captain', written after the martyred President's assassination. In the South, the greatest poet next to Poe was Sidney Lanier. His poems are filled with the love of nature.

Among lesser names, that of Bayard Taylor—essayist and poet—stands high. In addition to Poe and Lanier, the South had also, among others, the poets Paul Hamilton Hayne (1830–1886) and Henry



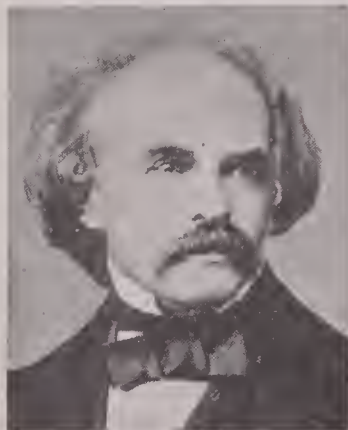
LOWELL
Scholar, Critic, and Poet

Timrod (1829-1867). The latter's 'Spring' expresses well the spirit of these poets:

Spring, with that nameless pathos in the air
Which dwells in all things fair,
Spring, with her golden suns and silver rains,
Is with us once again.
In the deep heart of every forest tree
The blood is all aglee,
And there's a look about the leafless
bowers
As if they dreamed of flowers.

Out of the Civil War time remain also a few memorable songs like 'The Battle Hymn of the Republic', by Julia Ward Howe, and 'Maryland, My Maryland', by James Randall; and a few poems such as 'Sheridan's Ride', by T. B. Read, and F. M. Finch's 'The Blue and The Gray'.

Good novels were slow to appear in America because of the lack of legend and tradition that novelists often use. But the time of the great poets and essayists brought also to fruition the genius of Nathaniel Hawthorne, whose exquisite style and deep penetration into human motives make him perhaps America's greatest novelist. Born and bred in old Salem, he put into his romances, 'The Scarlet Letter' and 'The House of the Seven Gables', an atmosphere that was Puritan New England itself.



HAWTHORNE
Genius of Romance

The real day of the novel did not come until after the war, but a good many stories were written before that. William Gilmore Simms and Herman Melville wrote adventure stories after the fashion of Cooper. A few others were

John Esten Cooke, another son of the South; Harriet Beecher Stowe, whose 'Uncle Tom's Cabin' did more to banish slavery than all the learned sermons and orations; Edward Everett Hale's stirring patriotic sketch, 'The Man Without a Country', falls in the midst of the Civil War struggle.

Not all the good and interesting writing has been done by poets and story-tellers. Historians, also, who have known their facts and could write picturesquely about them, deserve a place in our account. Of these William Hickling Prescott, whose 'Conquest of Mexico' and 'Conquest of Peru' glow with color and life to match the exploits of the Spanish conquerors, deserves first mention. John Lothrop Motley, who wrote 'The Rise of the Dutch Republic' and other books, gives us striking pictures of the heroic Dutch resistance to Spain. George Bancroft spent most of his long life on his 12 great volumes

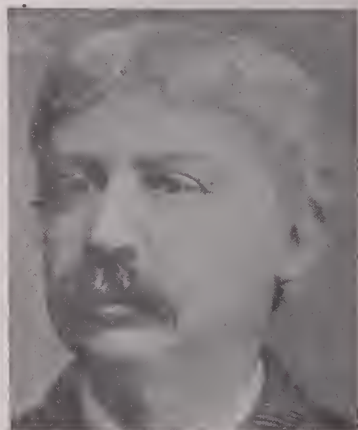
devoted to the history of the United States to the close of the Revolution and the forming of the Federal Constitution. Francis Parkman under conditions of ill health similar to those which hampered Prescott wrote most charmingly of France and England in the New World. We rejoice that the Indian life, as he saw it and described it in 'The Oregon Trail',

had so picturesque a chronicler; for, as he himself says, "the wild cavalcade that defiled before my eyes down the gorges of the Black Hills, with its paint and war plumes, fluttering trophies and savage embroidery, bows and arrows, lances and shields, will never be seen again."

If the poets and essayists held the center of the stage before the war, the novelists and short-story writers have had their turn since that event. So many good, even if not very great, novels have been written as to make difficult the task of selection. The writers, too,

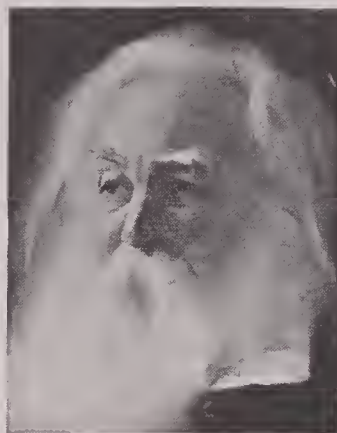
are no longer centered in New England and the East; they have sprung up all over the country—West, Middle West, and South as well.

Many of these novels picture life peculiar to the various separate localities of America. The West has been a favorite field from the time when Bret Harte, writing of the stirring lawless life of the California mining camps, started this new fashion in American fiction, the short story of "local color." Mary Hallock Foote, Helen Hunt



HARTE
Interpreter of Western Life

Jackson, Owen Wister, and Alice French have all written of the West. New England types and places have been represented in the novels of William Dean Howells, Mary E. Wilkins Freeman, Alice Brown, and Edith Wharton. New York life has figured in the stories of H. C. Bunner, Richard Harding Davis, Mrs. Burton Harrison, and that famous short-story writer, "O. Henry" (Sydney Porter). Edward Eggleston with his 'Hoosier School-Master', Booth Tarkington, known to all boys because of 'Penrod', and Hamlin Garland belong to the Middle States. The best tales of southern life are George W. Cable's 'Old Creole Days' and other books. War and reconstruction, negro



WHITMAN
"The Good Gray Poet"



HOWELLS
Master of Realism

life, old southern aristocracy, Kentucky and Tennessee mountaineers, appear in the books of James Lane Allen, John Fox Jr., "Charles Egbert Craddock" (Miss Murfree), Thomas Nelson Page, and F. Hopkinson

Smith. Joel Chandler Harris' delightful Uncle Remus stories are negro tales with the flavor of cabin and plantation, and have become classics.

History offers a fine field for the novel writer, and it is not surprising that American authors have found



BURROUGHS
 Lover of Nature

inspiration in the past of their own country. A few of the good historical novels are Winston Churchill's Revolutionary and Civil War tales, Mary Hartwell Catherwood's romances of early French history in the New World, Maurice Thompson's 'Alice of Old Vincennes', S. Weir Mitchell's 'Hugh Wynne', and Mary Johnston's 'To Have and to Hold'.

F. Marion Crawford, who spent most of his life in Italy, wrote his best novels and other books on Italian subjects. Constance Fenimore Woolson, Frances Hodgson Burnett, and Kate Douglas Wiggin have written good novels and short stories, some of them for children. Louisa May Alcott's books for boys and girls keep much of their popularity, as does General Lew Wallace's 'Ben Hur', a tale of the time of Christ. A famous woman novelist is Margaret Deland, author of 'Old Chester Tales' and many other volumes; and one of the most original and humorous American writers of fiction is Frank R. Stockton.

The three great outstanding figures in this crowd of fiction writers are William Dean Howells, Henry James and "Mark Twain." Howells, who has written many kinds of books, is most famous as a writer of novels like 'The Rise of Silas Lapham', in which he draws painstaking pictures of commonplace people, depending for interest on his insight into character



FIELD
 Poet of Childhood

and skill in writing rather than upon events in the story. Henry James, too, has written psychological novels; but he later developed a subtle and complicated style, and devoted himself to the representation of characters and situations equally subtle, with the result that he is best appreciated by the minority. 'Mark Twain' (Samuel L. Clemens) stands by himself as a humorist.

Everybody knows 'Huckleberry Finn' and 'Tom Sawyer'. But even his humorous books are thoughtful, and 'The Prince and the Pauper' and 'Joan of Arc' are fine pieces of serious writing.

There have been a number of historians also, since the Civil War, who have done notable work. Yet

there are few names that for literary skill could be placed alongside those of Motley, Prescott, and Parkman. Notable writers, however, were Hubert Howe Bancroft, voluminous historian of the Pacific states; John Bach McMaster, John Fiske, and James Ford Rhodes, all of whom wrote graphically of the history of the United States; Henry Adams, known for his 'History of the United States' (1801-1817) and his later 'Education of Henry Adams', a brilliant autobiographical book; Theodore Roosevelt and Woodrow Wilson, each of whom was a historian of rank as well as president.



TWAIN
 Prince of Humorists

Some of the most pleasing writing has been done by the nature essayists. After Thoreau, John Burroughs is supreme, for who combines knowledge, appreciation of beauty, and skill and charm in writing in equal degree with him? John Muir was another naturalist and essayist whose 'Mountains of California' and other writings are rich in wonderful descriptions. Henry van Dyke, more famous for the 'Blue Flower', 'The Other Wise Man', and some brilliant poems, was at his best when he wrote such outdoor essays as 'Fisherman's Luck'.

There have been almost as many poets as novelists, and any good collection of magazine verse is of necessity a large one. Yet, after all, the later poets are not among the very greatest. There were Joaquin Miller and Bret Harte, Thomas Bailey Aldrich (author of 'The Man with the Hoe'), Madison Cawein, and Edward Rowland Sill. Eugene Field made children's poems that older people like also—'Wynken, Blynken, and Nod' and 'Little Boy Blue'.

His work was not confined, however, to this field, for his humor played, now broadly, now with a fine delicacy of feeling, over a great variety of subjects—the free and open prairie life, classic stories, Bohemian city life and homely pleasures. James Whitcomb Riley wrote children's poems and Hoosier dialect verses full of homely philosophy and cheer, and became a truly national poet. But he was not confined to dialect, for many of his best works were written in purest English. Lucy Larcom found inspiration in such things as a factory girl's life. Alice and Phoebe Cary, Celia Thaxter, and Emily Dickinson all wrote verses that touch the heart. Remarkable because he



RILEY
 The Hoosier Singer

THE AMERICAN SPIRIT AS REVEALED IN LITERATURE

FAITH IN GOD

Truth forever on the scaffold,
Wrong forever on the throne,—
Yet that scaffold sways the future,
And behind the dim unknown,
Standeth God within the shadow
Keeping watch above His own.

—James Russell Lowell.

Our Fathers' God, to Thee,
Author of Liberty,
To Thee we sing;
Long may our land be bright
With freedom's holy light;
Protect us by Thy might,
Great God, our King.

—Samuel F. Smith.

JOYFUL LIVING AND ENDEAVOR

Oh! Let us fill our hearts up with the glory of
the day,
And banish ev'ry doubt and care and sorrow far
away!
For the world is full of roses, and the roses full
of dew,
And the dew is full of heavenly love that drips
for me and you.

—James Whitcomb Riley.

The longer on this earth we live
And weigh the various qualities of men,
The more we feel the high stern-featured beauty
Of plain devotedness to duty,
Steadfast and still, nor paid with mortal praise,
But finding amplest recompense
In life's ungarlanded expense
In work done squarely and unwasted days.

—James Russell Lowell.

The only life that is worth living is the life of
effort to attain what is worth striving for.

—Theodore Roosevelt.

Be strong!
We are not here to play, to dream, to drift;
We have hard work to do and loads to lift;
Shun not the struggle—face it. 'Tis God's gift.

—Mallie Davenport Babeock.

LOVE FOR THE OUT-OF-DOORS

If nature have a word for thee,
'Tis this, be brave; 'tis this, be strong;
Let all thy heart be full of cheer,
And fill the measure of the year
With thrill of happy song.

—Margaret Sangster.

Climb the mountains and get their good tidings.
Nature's peace will flow into you
As sunshine into trees;
The winds will blow their freshness into you,
And the storms their energy;
While cares will drop off like autumn leaves.

—John Muir.

The sublime beauty of the Yosemite filled me
with wonder and awe, but when I heard the
robin's note it touched my heart.

—John Burroughs.

LOVE OF COUNTRY

I pledge allegiance to my Flag,
And to the Republic for which it stands;
One Nation indivisible,
With liberty and justice for all.

—Children's Pledge.

Let our object be our country, our whole
country, and nothing but our country.

—Daniel Webster.

So it's home again, and home again, America
for me,
My heart is turning home again and there I long
to be,
In the land of youth and freedom beyond the
ocean bars,
Where the air is full of sunlight and the flag is
full of stars.

—Henry van Dyke.

DEFENDERS OF FREEDOM

I regret that I have but one life to lose for my
country.—Nathan Hale.

"Shoot if you must this old gray head,
But spare your country's flag," she said.

—John G. Whittier.

I propose to fight it out on this line if it takes
all summer.—General Grant.

As He died to make men holy,
Let us die to make men free.

—Julia Ward Howe.

Is life so dear or peace so sweet as to be pur-
chased at the price of chains and slavery? For-
bid it, Almighty God! I know not what course
others may take, but as for me, give me liberty
or give me death!

—Patrick Henry.

SONS OF LIBERTY

And thou, my country, write it on thy heart,
Thy sons are they who nobly take thy part;
Who dedicates his manhood at thy shrine,
Wherever born, is born a son of thine.

—Henry van Dyke.

Not gold, but only man can make
A people great and strong,—
Men who for truth and honor's sake
Stand fast and suffer long.

Brave men who work while others sleep,
Who dare while others fly,—
They build a nation's pillars deep,
And lift them to the sky.

—Ralph Waldo Emerson.

He serves his country best
Who lives pure life and doeth righteous deed,
And walks straight paths, however others stray;
And leaves his sons an uttermost bequest,
A stainless record which all men may read:
This is the better way.

—Susan Coolidge.

The greatest gift of God to nations is the gift
of upright men.

—Henry Ward Beecher.

is the greatest negro poet is Paul Laurence Dunbar, who wrote some very beautiful poetry, as well as amusing or pathetic dialect verse with negro rhythms. A few of the others are William Vaughn Moody, Edith Thomas, Josephine Preston Peabody Marks, Anna Hempstead Branch. The list must end somewhere, though somebody's favorite poet is sure to be left out.

The novel and the short story flourish still, of course, for Americans are tireless story readers. There have been novels dealing with later phases and problems of American life; wild tales of adventure; studies of young people. Booth Tarkington, Robert Herrick, Robert Grant, William Allen White, Ellen Glasgow, Dorothy Canfield, Stewart Edward White, Jack London, Theodore Dreiser, Henry Sydnor Harrison, Anne Douglas Sedgwick, Zona Gale, Ernest Poole, and Joseph Hergesheimer are a few of the 20th century names. The World War has brought its own literature of magazine tales, novels, essays, and travel books and accounts of personal experiences. Often these have been hurriedly written, and many will no doubt be forgotten when the times that made them interesting have passed. But the impress left by the great world cataclysm on American literature will not soon be effaced.

The most truly artistic developments in recent literature, perhaps, have been along the line of drama and poetry. The most interesting change is that made by the younger poets, who have tried to break away from old set standards of subject matter and form, and make their own verse forms to suit their own original thought. Many of those young radicals have written "free verse," somewhat after the fashion of Whitman. The best known of contemporary poets are Edgar Lee Masters, Vachel Lindsay, Edwin Arlington Robinson, Robert Frost, and Amy Lowell. The sincerity of these poets and their devotion to art for its own sake is, in a time when so much writing is done hastily to catch the average busy person's attention, at least a more hopeful sign of the appearance of something real and lasting in literature than any other recent development. (*See also* Drama; Novel; Poetry.)

AMIENS (ä-mē-än'), FRANCE. Towering above the low crowded houses of the ancient city of Amiens in northern France stands one of the greatest monuments left by the Middle Ages—its magnificent Gothic cathedral, the concentrated beauty of which is not surpassed by any church building in the world.

As the sun swings across the sky, the long shadow of this stone-ribbed giant sweeps from roof to roof of the low-lying houses of the city. It tells us of the days when those looming towers represented a power greater than that of king or state, and when the city dwellers seeing that shadow pass, looked upward with a mixture of fierce pride and fear.

Upon this cathedral the 13th century townsmen put the best of their talent and wealth. The richly carved facade, the big rose window above it, the lofty

height of the interior, lighted by marvels of stained glass, are beauties never to be forgotten.

Although Amiens was the General Headquarters of the British Army during the World War of 1914-18 and was frequently bombed by German airplanes and fired upon by long range artillery, this noble cathedral escaped serious damage. For its protection in those days the French piled bags of sand high over the facade, and masked the scores of statues.

At the beginning of the World War, during the

THE GOTHIC CATHEDRAL OF AMIENS



The western facade or front of the magnificent Amiens Cathedral is a marvel of elaborate Gothic decoration. The three portals are crowded with carefully and lovingly executed statues of saints, and the niches of the gallery just below the beautiful stained glass rose window contain 22 statues representing the kings of Judea. The interior is no less strikingly beautiful, with a central nave towering to the height of 140 feet.

thrust toward Paris, Amiens was briefly occupied by the right wing of the German army. Later its importance as a railway center and its commanding position on the Somme River made it the center of British army activities. The Germans made a determined but vain effort to regain the city in their opening drive of 1918.

The history of the city has been important since the days of the Roman Empire. Perhaps the most momentous event associated with its name is the famous treaty of Amiens between Napoleon and Great Britain, which was signed in the city hall, March 25, 1802, and which gave the British the only breathing spell they enjoyed during the wars following the French Revolution. It was the rupture of this treaty, in 1803, which enabled the United States to

purchase from Napoleon the Louisiana Territory, a possession which was too remote to be defended by the French.

Amiens today is the center of a rich district and has important manufactures of silk, woolen, and cotton cloths, ribbons and carpets. Amiens is 81 miles from Paris by rail. Population, about 93,000.

AMMONIA. This is a colorless pungent gas which is taken up by water with great readiness, thus making an alkaline liquid called ammonia-water, the ammonium hydroxide of chemists. This is the common form in which ammonia is used for household purposes. The name is probably derived from the temple of Ammon in the Libyan desert in Africa, where ammonia was produced. The name hartshorn is also used, because the shavings of horns have at times been used to prepare it.

Ammonia is composed of nitrogen and hydrogen, its chemical symbol being NH_3 . It is changed to a liquid or solid by cold and pressure. An important use of liquid ammonia is in the manufacture of ice (see Ice; Refrigeration).

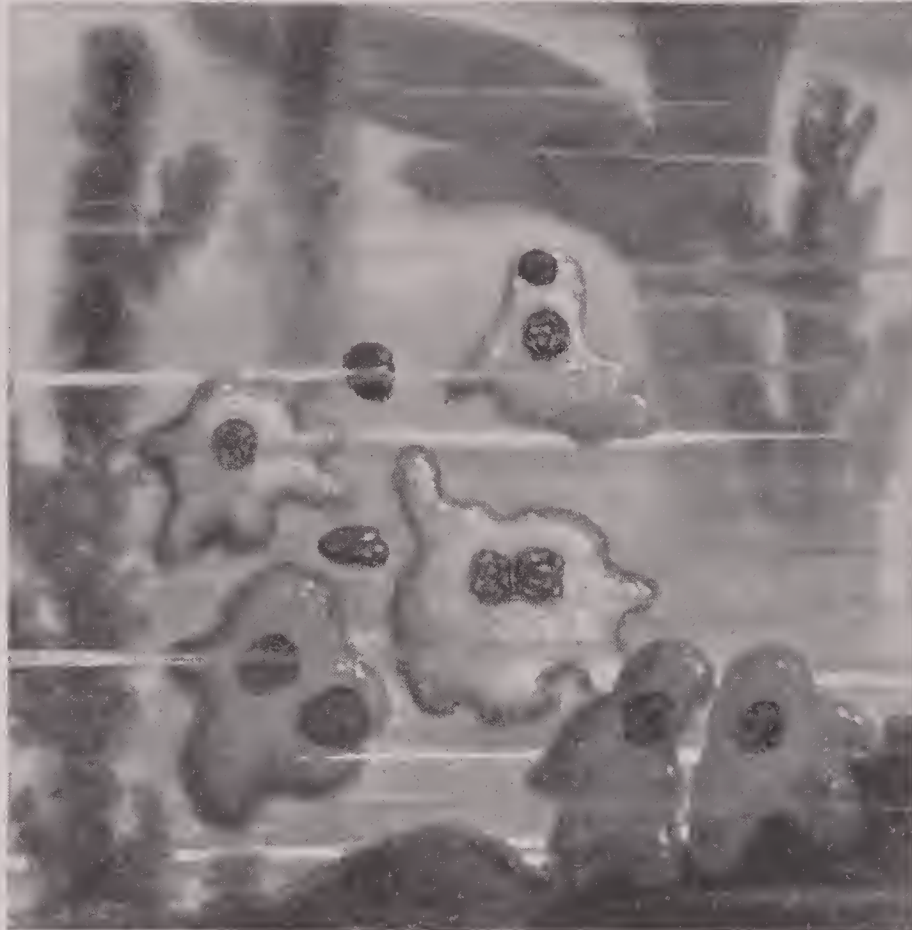
Until recently ammonia was obtained chiefly from the waste liquors in the manufacture of illuminating gas, but it is now manufactured on a large scale for the preparation of explosives by the direct union of hydrogen and nitrogen (see Nitrogen). Ammonia unites with acids to form ammonium salts. The carbonate (called also "sal volatile") is much used for smelling salts, the chloride ("sal ammoniac") is used in soldering and in medicine, and the sulphate and other salts are valuable fertilizers.

AMOEBAS (ă-mē' bā). In every pond and creek there are animals that are just as strange and varied as those in the menagerie of the circus or in the "zoo" of the city park. Some of these little animals are wonderfully small, as well as wonderfully made—so

small that thousands of them may live in a drop of water and you need a powerful microscope to see them.

The lowest forms of animal life, as of vegetable life, live in the water. The very, very smallest plant, such as the yeast plant, is just a single cell, too small to see without a microscope. It is alike all over, and gets its food by "soaking it in through the skin."

THE LOWEST FORM OF ANIMAL LIFE



One might imagine that an animal that could change its shape whenever it wanted to—like a fairy in a fairy tale—must be a very high order of animal indeed! But the facts are just the other way. The amoeba belongs to the very lowest form of animal life, and like other forms just learning the A B C of being, it lives in the water. Those two little figures in the lower right hand corner are not having a discussion (as one might think), but are twins that have resulted from the breaking in two of a single amoeba. Above and to the left of the twins is another amoeba just on the point of dividing. The dark spots near the center are the "nuclei," or life centers, which also divide just before the final breakup into twins. The other pictures show how the amoebas change their shapes and wrap themselves around their food. Of course, all these pictures are enormously magnified, for the amoeba is so small you cannot see it at all with the unaided eye.

One of the tiniest of animals is the amoeba, composed of a single cell—a tiny bit of a jelly-like substance called *protoplasm*. The name amoeba comes from a Greek word that means "change," and it is given it because the amoeba can change its shape whenever it wants to. Whenever the amoeba wants to move in a certain direction, little "feet" push out from that side of its body and draw the rest of the amoeba along. Whenever it wants to go in another direction it draws in these feet and makes feet on the other side. If you could put on a pair of wings as easily as the amoeba can make feet, you could do what every boy has wanted to do—fly like a bird.

But when it wants to eat it doesn't

make a mouth, and put food in this mouth, as you might suppose. Whenever it touches one of the smaller one-celled plants or animals on which it feeds, it simply wraps itself around it like a little boy trying to carry a big watermelon, till the food lies on the inside. Some of the little animals it eats have shells. When it is through with one of these it unwraps itself and drops the shell.

And it *seems* as if it had nerves, too. If you touch it, or shake it, it pulls itself together into just a little round bit of jelly. It will also move so as to keep in water of a proper temperature or to get away from strong light or any other unfavorable thing.

The amoeba also breathes. Although it has no lungs or gills, it takes in oxygen and gives out car-

bonic-acid gas, just as any other animal does when it breathes. The amoeba, in fact, has no true organs or specialized parts of any kind. The single cell of protoplasm of which it is composed does all the work of moving, eating, digesting, or breathing. In the central part of the cell, however, we see a little body which scientists call a *nucleus*. After the amoeba grows to a certain size, this nucleus divides and then the amoeba itself divides, and we have two amoebas where there was one before. These two amoebas themselves grow and divide often in about a day, and so we have four amoebas where formerly there was only one. In this way the race of the amoeba is continued and increased without parents or children, and without the individual amoeba ever growing old or dying except from accident or disease.

When you think of the wonderful little amoeba, and all of its cousins, the other *protozoa*, don't you believe that in a pool of standing water there are just as wonderful animals as in a circus? And don't you see, also, that in the animal kingdom, Nature begins spelling out her wonderful story in little easy words of one syllable, just as you learned to read when you began with the primer?

You may often find amoebas on the dead leaves in the bottom of pools, or in the home or school aquarium, or on the roots of duck weed and other small water plants. You may also put weeds from a pond in a glass jar filled with water, let it stand a few days in a warm room, and get specimens of amoebas and many other kinds of one-celled animals. Then you can watch them also through the microscope.

AMSTERDAM, HOLLAND. The city of Amsterdam, the capital of the Netherlands, has been well called the "Venice of the Netherlands." Like Venice it is cut up by canals into some 90 islands, and like Venice it is a city made great by its commerce. The houses are built on piles driven into the low-lying soil, and the first step necessary in the erection of a building is to pump the site dry. The buildings are usually of brick, six or seven stories high, with quaint pointed gables toward the street.

Amsterdam is the largest city in Holland and the chief center of Dutch industry. Founded in 1240 when a dam was built across the River Amstel,—from which the city took its name—Amsterdam had become by the 17th century the foremost commercial center of the world, at a time when the Dutch were

the greatest maritime nation. Since that date its importance has declined, but it still has extensive commerce and holds first place in the diamond-cutting industry, a business for which it is famous. It has also sugar refineries and factories for making silk, ropes, dyes, chemicals, and gold and silver plate. It is the financial center of Holland and its Bank of the Netherlands is one of the leading financial institutions of Europe.

The Dam—a large square that owes its name to the fact of its being the eastern boundary of the original dam across the river—is the axis around which Amsterdam is built. From it radiate in a semicircle the principal streets of the city, and every street-car in the place starts from the Dam. Near it stands the Royal Palace and the New Church. The former is the property of the city and when the rulers of the Netherlands make their annual visit they are literally the guests of the city. The Ryks or State Museum is another notable building and in it are displayed a number of the paintings of Rembrandt, Amsterdam's most noted son. The city owns the municipal abattoir in which all meat must be slaughtered, and a municipal pawnshop which will lend money on anything from a hair comb to a grand piano. Population, about 644,000.

AMUNDSEN (ă'-mŭn-sĕn), ROALD (1872-). The first man to reach the South Pole, and the first, it is believed, to circumnavigate the globe through the ice-bound waters of the Arctic regions—this is the distinction that belongs to the Norwegian

explorer, Roald Amundsen.

The son of a Norwegian ship-owner, he was born in Borge, Smaalenene, Norway. He was educated at the University of Christiania, where he studied medicine for two years. Then, answering the call of the sea, he entered the naval service. At 25 years of age he was chosen, because of his strength and skill and knowledge of the sea, as member of an important expedition to the Antarctic. Over six feet tall, with sea-blue eyes and blond hair, he had the powerful build and the dauntless spirit of the Norse vikings of olden times.

The Secret of Amundsen's Success

The more Amundsen saw of sea and land, the more he was fired with the ambition to seek farther and farther, to penetrate deeper and deeper into the mysteries of the Arctic and Antarctic circles. Not only was he fearless of danger and hardship, but he had the patience to spend years in study and preparation. This, together with his careful attention to the smallest details, his power of organization, and his knowledge of dogs and skill in handling them as draught animals, accounts for his wonderful success.

THE MINT TOWER IN AMSTERDAM



Here we see the Sophia-Plein, one of the many small public squares formed in Amsterdam by the intersection of its narrow winding streets. From the belfry of this massive Mint Tower, built in 1620, one of the finest views of the city may be obtained.

In 1903 he set sail in the ship *Gjøa* for the purpose of locating the magnetic North Pole. For 19 months he remained at King William Land in the north-eastern part of Greenland making observations, and as a result was able to show that the magnetic pole probably has no stationary position, but is in contin-

cause, and after the United States entered the war, he came to America at the request of the government to address American audiences, and especially those made up of persons of Norwegian descent, on his impressions of the war.

At last in the summer of 1918 Amundsen was able

AMUNDSEN AND HIS VOYAGES AT BOTH ENDS OF THE EARTH



The famous Norwegian explorer is shown here in the costume he wore when he made his famous dash over the Antarctic ice and snow and discovered the South Pole. Thick furs shielded him from the fierce cold winds that sweep the continent of Antarctica, while snowshoes and a stout stick held him up over treacherous crevasses.

At the left we see the map of this historic voyage. Entering the Ross Sea, he brought his famous ship, the *Fram*, to anchor in the Bay of Whales, in King Edward Land. There he spent the winter of 1911 (remember that the southern winter corresponds to the northern summer) and then started on his march for the pole. The map on the right pictures Amundsen's earlier passage through the Northwest Passage between the Atlantic and the Pacific—the dotted line showing how his ship, the *Gjøa*, most of the time frozen tight in the ice, drifted in 1904–05 through the maze of islands skirting North America.



ual movement. On this expedition, too, he traversed what navigators had been seeking for hundreds of years—the Northwest Passage from the Atlantic to the Pacific. This completed the first leg of his Arctic journey around the world.

The Dash to the South Pole

Returning to Norway, he made plans for an expedition in Dr. Nansen's ship, the *Fram*. This time he intended to drift right across the North Polar Sea. Then came the news that the American explorer Peary had discovered the North Pole, so Amundsen decided to make for the South Pole instead. The story of how he and his men wintered at the edge of the Great Ice Barrier on the Bay of Whales, and how they made their glorious dash over mountains and perilous glaciers to the South Pole, is told elsewhere in this work (see *Polar Exploration*). Honors were heaped upon Amundsen, and he lectured in most of the countries of Europe and North America, and in Australia. His book 'The South Pole' was translated into almost every language.

But he did not rest on his laurels. In 1914 he was making preparations for another expedition, which he was forced to postpone, however, on account of the World War. Although his own country was neutral, he sympathized warmly with the Allies'

to set sail for the north polar regions. His plan was to drive his ship as far northward as he could, then to lodge it in the ice, and allow it to be dragged along with the enormous floes. He expected that it would take him near the North Pole. His purpose, however, was not primarily to reach the pole, but to make scientific observations in the far north. For 19 months he was not heard from. Then he arrived at Anadyr, a trading post on Bering Sea in eastern Siberia, in April 1920, having left his ship and companions fast in the ice and come some hundreds of miles by sledge to seek supplies and news of the civilized world. In July he was in Nome, Alaska, on the opposite side of Bering Strait. He had sailed from the Atlantic to the Pacific across the seas bordering northern Europe and Asia, thus completing the second leg of his journey around the Polar Circle, which he had begun in 1903. After a couple of weeks

spent in Nome, he set out to rejoin his ship prepared for a five-year sojourn in the Arctic regions. Though suffering from injuries received in a hand-to-hand combat with a polar bear the year before, he was still dauntless in his purpose—to add to his glory as discoverer of the South Pole the honor of reaching the North Pole as well.

ANATOMY. Why cannot an automobile fly like an airplane, or a sewing machine be used to saw wood? The answer is that every machine is built in a certain way, and what any machine can do depends on how it is constructed. Likewise every kind of animal and every kind of plant has its own peculiar structure, and its method of life depends on its structure. The science that studies the structure of living things is anatomy. It gets its name from the Greek words meaning “to cut up.”

That branch of anatomy which is concerned with the very complex structure of the human body is human anatomy. If the microscope is used to make out the fine structure, we call the study microscopic anatomy or histology. The study of the changes caused by disease is pathologic anatomy or pathology. The study of the body from the viewpoint of performing operations is called surgical anatomy. From a practical standpoint this is very important. Unless the surgeon knows the structure of the body he might cut an important nerve or blood-vessel.

In comparative anatomy the structure of the higher animals is studied and comparisons made one with another and with lower ones from which they have developed. Comparative anatomy is important to the zoologist and botanist. In these connections it is usually called morphology, a name contrasted with physiology. In the broad sense morphology includes the construction of all plants and animals from the simplest to the highest. Finally we have anatomy for artists, nurses, and those engaged in physical education.

How the Study of Anatomy Began

Physicians and medical men were the first to take an interest in the anatomy of the human body, because a knowledge of it is necessary for medicine. It thus happens that the earliest observations in this line were directed toward making known the structure of the human body and of animals rather closely related to man in points of structure. Anatomical study, therefore, began with the most complex animals instead of with the simpler ones, and this led to many misunderstandings. It was so difficult in the early days to get an opportunity to study the human body that the pioneer anatomists were obliged to gain their knowledge by dissections of animals like the dog and monkey.

About 300 B.C. the dissection of the human body was legalized in the school of Alexandria, Egypt, the bodies of condemned criminals being devoted to that purpose. But this did not become general, and anatomy continued to be studied mainly from brute animals for nearly 2,000 years longer.

In the early part of the Christian era, the writings of the Greek physician Galen (130–200 A.D.) became accepted as authority, and continued as such until the revival of anatomy by Vesalius in the 16th century.

During the thousand years of the Middle Ages there was little progress in anatomical knowledge, owing to the fact that the church prohibited the dissection of the human body, and also because dissection was considered beneath the dignity of doctors and was left to ignorant barbers. Vesalius (1514–1564), a Belgian, left the universities of Louvain and Paris because of the difficulty of getting material for dissection, and went to the republic of Venice, where a liberal spirit prevailed; and at the age of 22 he became professor of anatomy and surgery at Padua, Italy. He laid the foundations of modern anatomy, correcting many errors of Galen. Soon other men came to rely on their own observation and to believe their own eyes instead of what had been written in books. Then anatomy and other sciences advanced rapidly. The school at Padua became deservedly famous, and students were attracted to it from all over Europe and Britain. From England, William Harvey (1578–1657) found his way to Padua as a medical student. In the early part of the 17th century, he made an epoch in both anatomy and physiology by the demonstration (1628) of the circulation of the blood. Among the famous Italian teachers in anatomy following Vesalius were Fallopius and Eustachius (from whom is named the Eustachian tube of the ear). Thus in the 16th century human anatomy was well established.

Recent Progress in the Science

The subject became broadened, especially by the work of the Frenchmen Cuvier and Bichat at the opening of the 19th century. Naturalists began to take more interest in animals and plants, and there gradually grew up those who compared the structure of higher animals with the simpler ones. These comparisons brought out so many resemblances and so many remarkable facts regarding construction that anatomy, which seems at first a dry subject, became endowed with great interest.

This is, briefly, the story of the rise of anatomy. It shows how the study began with a narrow aim—that of making known the structure of the human body for use of medical men—and has now become an important department of biology, dealing with the development of life and the structure of all living things.

ANDERSEN, HANS CHRISTIAN (1805–1875). Do you know the story of the Ugly Duckling that turned out to be a beautiful Swan? It is really a story of the author's own life; for little Hans Andersen was a long, lank, ungainly, awkward boy, as odd in his ways as in his looks, and no one in his boyhood could have guessed that some day he would become one of the world's famous men.

In a little town in Denmark he lived in one small room, which served also as a workshop for his father,

a poor cobbler. When Hans was 11 years old the father died, the mother had to go out washing, and the little boy was left to himself. He played with a toy theater, made clothes for the puppets, read plays,

ANDERSEN AND HIS DREAM CHILDREN



This is the great story-teller and some of the children of his dreams that have already charmed the children of several generations and will probably continue to delight others so long as little people delight in fairy stories. How many of your favorites do you recognize? Of course, you can't miss "The Flying Trunk," nor "The Little Mermaid," nor "The Story of What the Moon Saw." And then there is "The Little Match Girl" and "Little Claus and Big Claus."

and invented stories. People laughed at the silly boy and wondered what would become of him. When he was sent to school he dreamed and idled away his time and learned very little.

A Dreamer from His Youth

He always felt that something wonderful was going to happen to him, just as in fairy tales. When he was 14 he went to the city of Copenhagen to try his fortune. He wanted to become an actor or opera singer, but he was turned away from the theaters and reduced almost to starvation. He determined that he would write plays if he could not act them. In this he failed, too, at first; but a kind friend saw that he had talent and induced the king to help him get an education. He kept on writing dramas, poems, and sketches, and finally produced a novel, 'The Improvisatore', that brought him popularity. At last the poet's troubles had come to an end.

Ever since he was a little boy he had made up fairy tales, and children were delighted to hear him tell these stories. Someone suggested that he should write some of the stories down and put them in a book. He laughed at the idea, but decided to do it just for fun; and in 1835 the first volume of his immortal 'Fairy Tales' appeared. Before long he had become the idol of his own country and of all Europe.

The Ugly Duckling had proved to be a Swan. He was still awkward, to be sure, and he continued to dress in odd old-fashioned clothes, but children forgot all about his queer appearance when they listened to his wonderful stories. On his travels he was received everywhere like a fairy prince. When as an old man he wrote the story of his life, he called it a "wonder story." "How beautiful the world is!" he said, when he was dying. "How happy I am!"

His statue stands in one of the public gardens of Copenhagen. Children play about it and look up into the kind homely face of the great writer, who stands there, book in hand and with finger uplifted, as if calling on them to listen to one of his immortal stories.

Besides his fairy tales, Andersen's chief works were: 'A Journey on Foot from Holman's Canal to the East Point of Amager' (1829); 'The Improvisatore' (1835); 'Only a Fiddler'; 'Picture-Book Without Pictures' (1840); 'Story of My Life' (1853); 'In Spain' (1863).

ANDES MOUNTAINS. In the largest geographic sense the Andes are a part of the "world ridge" which nearly encircles the Pacific Ocean from the tip of South America, through Alaska, Japan, and the Philippines, to New Zealand. The Andes portion of this world ridge forms the longest mountain system on earth, for it extends from the Isthmus of Panama to Tierra del Fuego, a distance of 4,500 miles.

Ranging from the tropic heat of the northern coast to the frigid temperatures of the glaciers of Patagonia and of the snow-clad cones which rise under the equatorial sun, the Andes present a variation of climate that is unique. North of Chile the snow-line has an elevation of some 15,000 feet, and the broad plateaus below have the climate and products of temperate zone valleys. These regions were thickly populated by advanced tribes of Indians when Spanish explorers conquered them 400 years ago, and they are today the chief centers of population.

The Andes and the Rains

In the northern part of the continent the winds blow westward from the Atlantic, and give up their moisture as they rise over the mountains. As a result the eastern slopes of the Andes are deluged with tropical rains. Thus the Amazon is supplied with the greatest flood of waters that any river system on earth pours into the ocean; while just across the mountains on the Pacific slope lie the arid deserts of Peru and northern Chile. In the south, westerly winds prevail and the coastal plain and central valley of southern Chile are well watered, while east of the Andes in

the same latitude are the dry plains of western Argentina.

Except in the extreme south, the Andes are all but uncrossable. The high passes are mere gorgelike channels of mountain streams, with paths for pack mules and llamas winding along the overhanging slopes. Only at one point has a railroad been carried over the Chilean mountains. By awe-inspiring feats of engineering, by trestles across fearful chasms, and by bridges suspended at dizzy heights above stupendous abysses, the Trans-Andean railroad has been built (completed in 1910) to connect Valparaiso with Buenos Aires. Some day the projected Pan-American railway will run southward from Panama to the capital cities on the central plateau.

Mineral Treasure Locked in the Mountains

Fabulously rich mines of gold, silver, and copper were worked by the Incas and their Spanish conquerors. Deposits of lead, iron, platinum, quicksilver, and tin also exist. Indeed the Andes are so rich in minerals that their name is from the Indian word *anta*, which means copper, or metals in general. But these mountain fastnesses are so inaccessible and forbidding that the greater part of their wealth may long remain undeveloped.

The Spanish name for the Andes is Cordilleras, from an old word meaning a cord or rope. At their narrow southern end the Andes form only one distinct range, which descends to Cape Horn in foothills and rises again in glaciated volcanic cones on Tierra del Fuego ("the land of fire"). In Chile a low coast range and high rocky ridges called *sierras* inclose a wide central valley. From Peru northward the mass widens to 400 miles and is lifted to extensive plateaus bounded and crossed by lofty ranges and peaks. From Ecuador and Colombia, the Andes descend toward the low isthmus and throw out eastward a great spur along the coast of Venezuela.

The plateaus and passes of the Andes are as elevated as the highest summits of the Alps, and peaks towering up to 23,000 feet overtop everything on earth except the summits of the Himalayas. Chimborazo (20,517 feet), Sorata (21,484 feet), Illimani (21,024 feet), and Aconcagua (22,860 feet) are among the highest peaks. As the Andes parallel the Pacific, in places rising in sheer cliffs from the coast, they appear in their greatest grandeur from the deck of a steamer at sea. Above this colossal upheaval rise the smoke-plumes of 36 active volcanoes. Cotopaxi (19,580 feet) has the distinction of being the highest active volcano in the world. The entire Andean system is subject to violent earthquakes, which have devastated cities from Caracas to Valparaiso.

ANDRE (*ăn'drā*), JOHN (1751-1780). During the American War for Independence two men were arrested and hanged as spies. One was the American Nathan Hale, who was executed by the British; the other was the Englishman John Andre, who was arrested and hanged by the Americans.

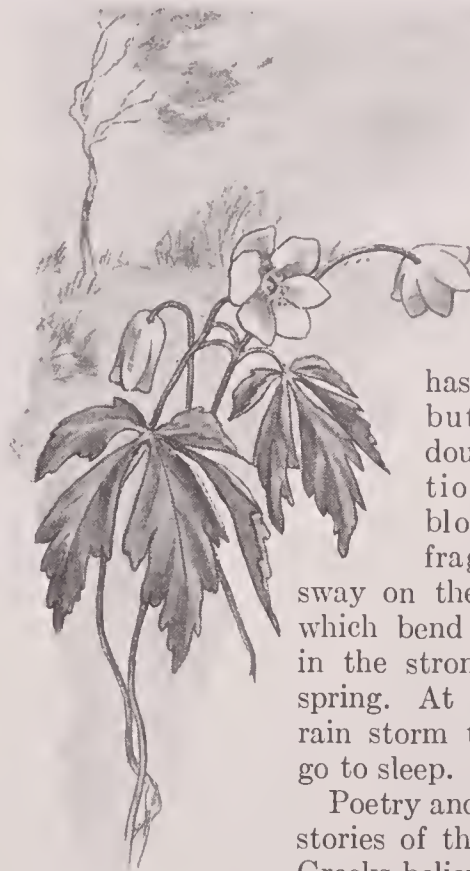
The name of Andre, a man of fine honor, is always associated with that of Benedict Arnold, the traitor, for it was in order to meet Arnold that Andre came within the American lines, and so became a spy. Arnold had decided to betray West Point on the Hudson to the British, and on the night of Sept. 21, 1780, he contrived to have Major Andre brought ashore from the British ship *Vulture*, which was lying

in the river below West Point. At the meeting of the two men Andre received plans of the fort from Arnold, which he had accepted in violation of the orders of his commander, who had told him to have nothing to do with papers. At the close of the interview Arnold returned to West Point and Andre attempted to return to the British camp.

On the way Andre was stopped by three men. He thought they were British sympathizers and so told them that he was a British officer. Unfortunately for him the men were really American irregular troops, who promptly took him to the nearest American headquarters. The officer in charge stupidly sent a letter to Arnold telling of the capture of the spy, so the traitor was able to escape to the British. Andre was tried, condemned, and executed as a spy. "His death, though according to the stern rule of war, moved even his enemies to pity; and both armies mourned the fate of one so young and so brave."

Today the body of Major Andre rests in Westminster Abbey among those of the famous men of England. On the spot where he was executed stands a monument which bears on one face the words of Washington: "He was more unfortunate than criminal. An accomplished man and gallant officer."

ANEMONE (*ă-nēm'o-nē*). One of the most beautiful of our spring blossoms is this little "wind flower," as it is sometimes called, which grows wild in woodlands and pastures. When found in the shade the colors are pink, rose-color, or purple; but in the sun they are white or slightly flushed with rose. The wild anemone



has single flowers, but they can be doubled by cultivation. The dainty blossoms, slightly fragrant, nod and sway on their slender stems, which bend but never break in the strong blasts of early spring. At night or during a rain storm they curl up and go to sleep.

Poetry and myth give many stories of the anemone. The Greeks believed that it sprang from the tears dropped by the goddess Aphrodite (Venus) as she wept in the forest over the death of her lover Adonis. They believed, too, that only the wind could open its petals.

The anemone, which belongs to the crowfoot or buttercup family, is closely related to the hepatica and has many species. It grows in many parts of Asia, is greatly prized by the Chinese who use it in their funeral rites, and is a great favorite in Europe as well as in Canada and the United States.

Scientific name of the common wood anemone, *Anemone quinquefolia*. Flowers are about 1 inch across, with calyx of 4 to 9 oval, petal-like sepals, but no petals; numerous stamens cluster about the small green pistils. The slender green stem grows at right angles to the long horizontal root-stock. The leaves grow in whorls of 3 to 5 (whence the name quinquefolia) below the flower; they are divided into 3 to 5 notched and lobed parts.

ANESTHETICS. No other single achievement of science has done so much to relieve human suffering as the discovery that certain chemicals could be used to stop all sensations of pain during surgical operations. These chemicals are called "anesthetics," and the effect they produce is called *anesthesia*, a Greek word meaning "without sensation" introduced into the English language by Oliver Wendell Holmes, who was one of the first to recognize the great boon to humanity.

Until the middle of the 19th century surgical operations were performed while the patient was fully conscious, strapped to the operating table. Many life-saving operations could not be performed at all, and human beings died by the thousands because three simple chemicals—*ether*, *chloroform*, and *nitrous oxide* (laughing gas) were still practically unknown.

The credit for first discovering anesthetics is a matter of dispute. In 1800 Sir Humphry Davy, a great British chemist, announced experiments with nitrous oxide, and suggested the use of this gas in surgery; but his suggestion was unheeded. In 1818 Michael Faraday, another noted British chemist, showed that ether also had similar anesthetic effects. It remained for America first to put these chemicals to practical use. In 1842 Dr. Crawford W. Long of Danielsville, Ga., successfully removed a tumor from a patient who was under the influence of ether, but for years he was not given credit for his pioneer work because he did not publish reports of this and similar operations. Two years later, Dr. Horace

Wells, a dentist of Hartford, Conn., proved the value of nitrous oxide by having a tooth extracted while under its influence. In 1846 Dr. W. T. G. Morton, a Boston dentist, used ether with success on a number

SIR JAMES Y. SIMPSON DISCOVERING THE POWER OF CHLOROFORM



This picture shows how Sir James Y. Simpson and two of his friends risked their lives in the endeavor to discover a better anesthetic than ether. You see Sir James is just coming to, while his friends are still unconscious from the vapor of the chloroform they had inhaled. "My first thought," said the great scientist, "was: 'This is much better than ether!'"

of patients and administered it later with equal success in surgical cases. And in 1847 Sir James Y. Simpson, an English scientist, announced his discovery of the anesthetic properties of chloroform.

At first these pioneers met with great opposition. But when it became known that Queen Victoria had taken chloroform during medical treatment, the last obstacle was removed.

Although many other drugs have been found with anesthetic properties, the three already mentioned are still the most commonly used. A brief description of each will suffice.

NITROUS OXIDE.—This is called "laughing gas" because when inhaled in a weak mixture it tends to make the patient

a great success, however, as it varies widely in its effects on different patients.

LOCAL ANESTHETICS.—The methods already mentioned produce complete anesthesia, in which the whole body is rendered insensible to pain. There are other methods, however, which produce *local anesthesia*, and which are now much in use. A fine spray of ether or ethyl chloride, for instance, will freeze any part of the skin, which may then be cut without sensation, but the after-effects are as painful as in severe frost-bite. Many drug compounds such as cocaine, eucaine,

THE SLEEP THAT SAVES FROM PAIN



These illustrations show two ways in which anesthetics are administered. In the upper, the patient is being given ether, which falls slowly drop by drop from the bottle to a piece of cotton in a mask over the patient's face. From this he inhales the vapor that brings the sweet oblivion to pain. In the second picture "laughing gas" is being administered. The mouth and nostrils are completely shut out from the outside air by a rubber mask which fits close to the face. Through the glass the operator can watch the face of the patient and so see how the anesthetic is taking effect. The cylinder with which the tube is connected contains the nitrous oxide.

laugh immoderately. It is a colorless and odorless gas, consisting of two parts nitrogen and one part oxygen. A few breaths of a proper mixture are enough to make the patient unconscious and in expert hands there is absolutely no danger, nor does it have any unpleasant after-effects. However, it does not produce the complete muscular relaxation often required in major operations, and its use is generally confined to dental work and minor surgery.

ETHER.—The scientific name of this gas is *diethyl oxide*. It is colorless, but has a very pungent suffocating smell. For this reason the patient is usually made unconscious with nitrous oxide before ether is applied. It is considered less dangerous than chloroform, but sometimes has a serious irritating effect on the lungs and is not used for patients with tendencies to pulmonary trouble. Recovery from ether is nearly always accompanied by nausea.

CHLOROFORM.—This is also a colorless gas with a strong sweetish odor, not altogether unpleasant. It is perhaps the most powerful of all anesthetics, and is not ordinarily used for patients with weak hearts. The symptoms of recovery are not so violent, however, as with ether. It is preferred by European surgeons, while American doctors incline towards ether. The number of deaths on the operating table traceable to chloroform is about 1 in 3,000.

Two other anesthetics have recently come into occasional use, *ethyl chloride* and a mixture of *scopolamin* and *morphine*. The former is a gas resembling in its effects both nitrous oxide and ether. "Twilight sleep" is the semi-conscious condition produced by the *scopolamin* mixture administered by injection through the skin. It leaves the patient apparently semi-conscious and able to move, but after the operation there is no recollection of the ordeal. It has not proved



novocaine, *stovaine*, etc., are preferred for local operations. They are injected in the region which is to be operated upon and create numbness in that part alone, leaving the patient fully conscious. Such local anesthesia does away with the element of danger and with most of the unpleasant sensations of recovery, but cannot be used successfully in the more serious major operations.

A process which has been successful in many operations upon the lower part of the body consists in injecting some anesthetic drug like *stovaine* into the sheath which contains the fluid around the spinal cord. As a result the patient ceases to have any feeling from the point of injection downward. The delicacy of this operation, however, makes it difficult.

A new method called *nerve-blocking* has very recently aroused much interest. No drugs whatever are used. The skilled specialist finds the chief nerve cord leading to the spinal column from the place to be operated upon. Sharp pressure is brought to bear upon this nerve and soon all feeling disappears in the region to which it leads. The effect is the same as when a person's arm or leg "goes to sleep," which like nerve-blocking is simply the result of accidental and prolonged pressure on the central nerve of the arm or leg. Many important operations have been performed in this way. (See also Hospitals; Medicine and Surgery.)



One of the mysteries which science has not yet fathomed is the extraordinary difference in the length of life of various animals. The May-fly for example, which springs from its pupa case at 1 o'clock is approaching old age by 4, and by 5 o'clock is dead; while it is believed that there are whales alive today which might have beheld the landing of the Pilgrims on Plymouth Rock. Here we see the maximum age attained by many of the commoner creatures. Some of these ages, such as that of the golden eagle, are matters of actual record. In the case of whales, turtles, and some other long-lived animals, age is estimated from the rate of growth of whalebone, shell, etc.

For any subject not found in its alphabetical place see information

The VARIED WEB of ANIMAL LIFE

ANIMAL KINGDOM.

What is the difference between plants and animals? A noted scientist once said that "plants are animals that have made a business of standing still." That is a good rough-and-ready distinction but it will not fit all cases, for there are a few animals like sponges and corals that remain fixed in one place nearly all their lives. It is easy enough to tell one of the higher animals from one of the higher plants, but it is not so easy when we get down to very primitive types of life like the sea-anemone. In fact, there are certain very low forms of life—especially those minute one-celled organisms from which scientists believe all higher forms have developed—which even the most learned men do not know how to classify. As we go up the scale of life, however, we find one fairly clear distinction, in addition to the fact that nearly all animals move and have special organs for moving, while most plants do not. That distinction is this: nearly all plants get their food from gases in the air and chemical substances in the soil and water, while animals live by eating plants and other animals.

The struggle for existence in the animal world therefore seems fiercer and more cruel than among the plants. The three great things in an animal's life are to eat, to avoid being eaten, and to continue its kind. Throughout the animal kingdom we find the most marvelous adaptations to carry out these purposes. Thus the lion and the tiger are provided with long claws and sharp teeth for capturing their prey. The porcupine has sharp bristles to drive away an enemy; the skunk drives off his pursuers by throwing off a disgusting odor; and the flying-fish actually leaps out of the water and escapes danger—by the use of its winglike fins. Still another example of adaptation is the bright plumage of birds, which is their show dress during the mating period. There are also butterflies whose wings so perfectly imitate the blossoms or leaves of trees that when they attach themselves to the proper twigs only the keenest eye can pick them out.

Animals that are not well adapted to the struggle for life soon die off and disappear. As it is, nature produces millions of animals which survive only for a brief period; in the great struggle for existence enormous numbers die when young or are killed and eaten by other animals. If this were not the case a single species would soon overrun the entire earth. The conger eel, for example, is said to lay 15,000,000 eggs. It is estimated that if each egg grew to ma-

HOW amazing are the variations of structure and habit included in the Animal Kingdom, and how fascinating is the study! From the tiny one-celled Amoeba to Man, there are more than half a million known forms of animals, differing enormously in size, form, color, and mode of life—in the ways they get their food, in their adaptation to the struggle for existence, in their wonderful manifestations of animal instinct, often surpassing man's powers of reason. Every day science turns over a new page in the living book of Nature, and gradually we have learned to read the great laws that govern this maze of struggling beings, from the tiniest animal germ to the gigantic Whale.

turity, and reproduction continued at the same rate, every ocean and sea would be full of conger eels within ten years.

The length of life of an animal seems to be connected in some way with its size and the rate at which it multiplies. The largest animals, which have few young, such as

the whale with a span of life believed to be 300 years or more, and the elephant, which sometimes reaches the age of 150, seem to live the longest. On the other hand certain flies which multiply very rapidly live only a few hours. Some animals such as turtles, crocodiles, and many snakes live to great age, apparently because they lead such sluggish lives.

After thousands of years of study scientists have been able to trace out the general design of this great web of life. They have learned that all the animals, from the tiny one-celled *amoeba* to man himself, are related to one another; and they have classified all the various kinds of animals—more than 500,000 of them—showing how they are related. At the head of the animal world they place man, in the same group with the monkeys, the manlike apes, and the other animals that nurse their young. For man, we know now, is closely related in structure to these animals, and differs from them rather in the development of his intelligence than in his bodily structure (see *Evolution*).

One of the simpler schemes of classification, in which the whole animal kingdom is divided into eight branches, is as follows:

1. *Protozoa*. The simplest animals, microscopic and usually composed of a single cell such as the amoeba or the malaria germ; if of several cells, these are all of one kind. (All the remaining groups are many-celled and are collectively called *metazoa*.)
2. *Porifera*. Sponges.
3. *Codenterates*. Jellyfishes, sea-anemones, coral animals, etc.
4. *Vermes*. Worms, a very large group, often separated into several branches; includes jointed worms, smooth worms, shelled worms, tapeworms, etc.
5. *Mollusks*. Clams, mussels, snails, oysters, slugs, devil-fishes, cuttlefishes, and squids.
6. *Echinoderms*. Animals with spiny skeletons like starfishes, sea-urchins, sea-cucumbers, etc.
7. *Arthropods*. Lobsters, crabs, crayfish, spiders, centipedes, bees, ants, butterflies, beetles, etc. There are 400,000 known species in this branch, more than all the known species in all the other branches combined.
8. *Vertebrates*.
 - (a) *Fishes*.
 - (b) *Amphibians*. Frogs, toads, and newts.
 - (c) *Reptiles*. Snakes, lizards, alligators, turtles.
 - (d) *Birds*.
 - (e) *Mammals*. Animals that nurse their young, including man.

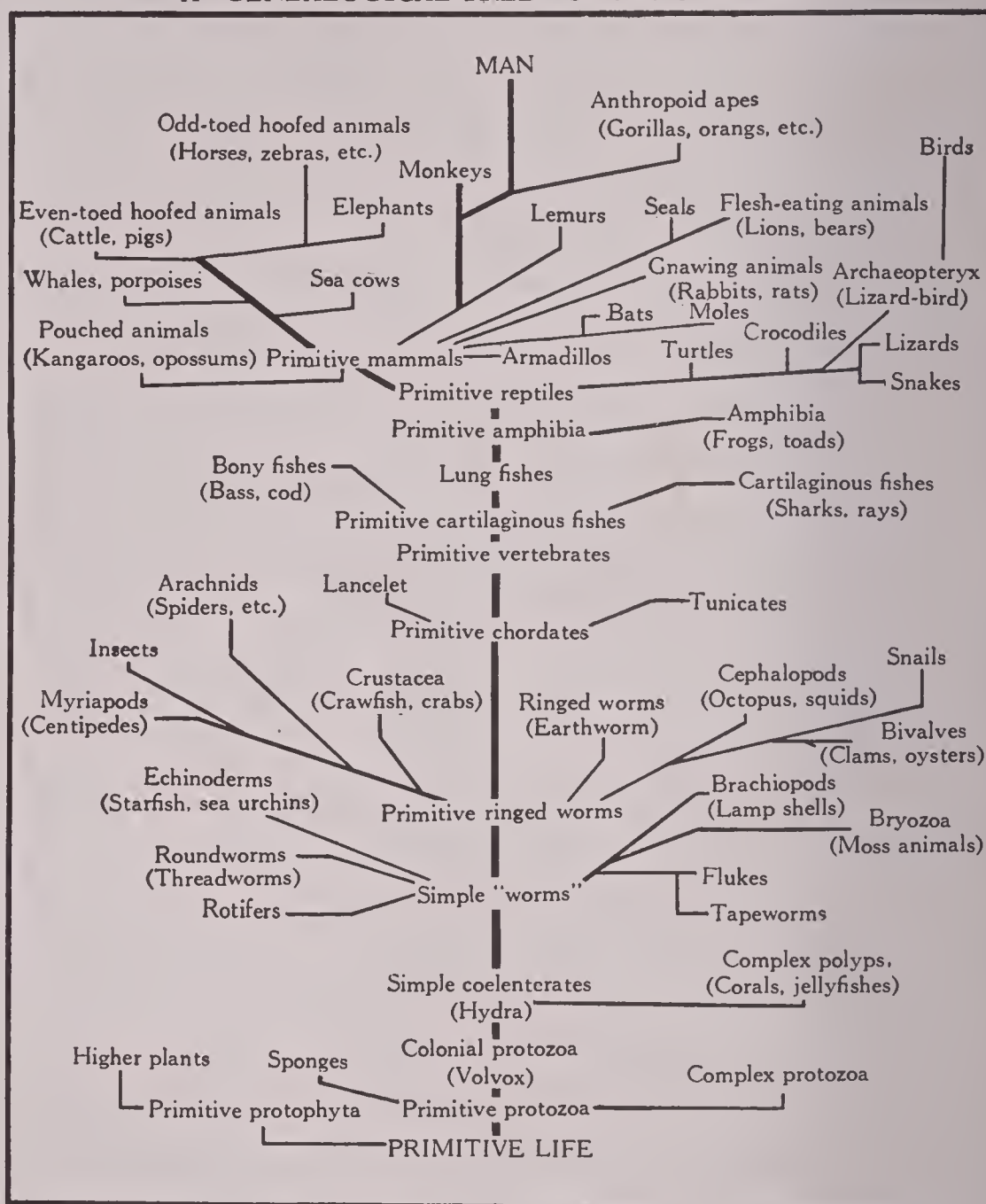
The accompanying "genealogical tree" shows, in a general way, many things of the relationships, progress of evolution, and relative complexity of the animals which compose the main groups of the animal kingdom. The position of groups in the scale of life is pretty closely shown, with the simplest forms of life at the bottom of the page and the highest at the top. It is often said that a "genealogical tree" of the animal kingdom is much like a real tree, with only the end twigs shown, and the trunk and main limbs left out. This means that, in the evolution of life, the more primitive forms of life almost all disappear or evolve into higher forms of life—very much as the original Puritan type of New England has evolved into the somewhat changed descendants of New England of today, and the more changed descendants of more remote parts like Kansas. So the stages marked "primitive" in the "tree" are mainly hypothetical. A "tree" may be of great help in viewing the animal kingdom in a large and comprehensive way, but it must always be remembered that the relationships and origins are not matters of scientific demonstration, like most matters of science.

In evolution it is the more primitive types all the while, and not more specialized forms, that evolve into higher types—much as a boy and not a man is taken for training in some highly specialized vocation. Crabs, for instance, could not be used to evolve vertebrate animals. As the "tree" shows, while primitive types have evolved into new and higher types, some of their relatives have remained at pretty much the old level, with only slight evolution. For instance, while the many forms of higher mammals have evolved from primitive mammals, some of the latter have changed but little relatively, and are still found as the lowly mammals known as marsupials or pouched animals.

Keeping in mind that the details of the "tree" are only probable, we may trace some of the main events in the evolution of animal life. Primitive life gave

rise to the simplest single-celled plants and animals, which were the points of departure for the evolution of the plant and animal worlds. The simplest protozoa were to give rise to the thousands of kinds of protozoa of great variety, as well as to colonies of protozoa—colonies of cells—and these to forms sim-

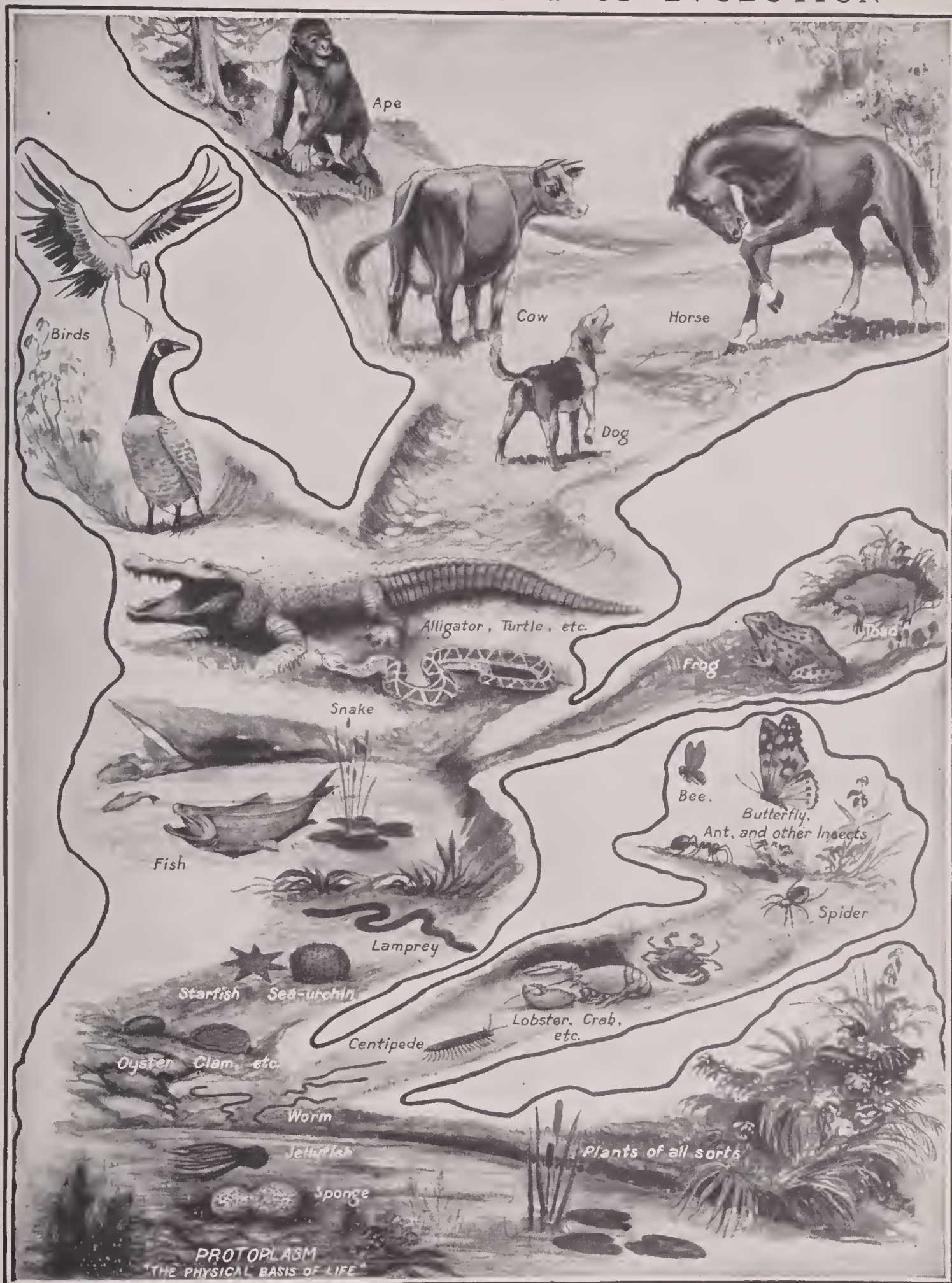
A "GENEALOGICAL TREE" OF THE ANIMALS



ilar to the hydra. The hydra-like animals gave rise to the more specialized polyps and jellyfishes, as well as to higher animals.

One of the most interesting and important hypothetical types is a form more complex than the hydra, which became the point for the evolution not only of the higher forms of life but also of the large number of diverse types often classified together as "worms." These "simple worms" in the "tree" were not worms as you usually know them, but probably very small and simple, perhaps swimming and crawling, and not jointed. The first origins of the starfish group must have been very early in the evolution of life, but at best they are very obscure.

THE WONDERFUL STORY OF EVOLUTION



The greatest chapter in the whole wonderful history of science—the story of evolution—is here shown in striking form. Beginning with protoplasm, the physical basis of all life, we find first the division into plant and animal groups. Following the animal branch we come to such simple creatures as the sponge and the jellyfish; then the worms, which branched on one side into the centipedes, lobsters, crabs, spiders, and insects, and, on the other side, into such animals as the starfish and sea-urchins. With the lamprey come the early forms of vertebrates or backboneed animals. We even find the fish, which separate on one side into the amphibia (such as frogs and toads), and on the other into reptiles. The reptiles in turn developed into birds and mammals, leading up to the manlike apes and finally to Man himself.

contained in the Easy Reference Fact-Index at the end of this work

One of the most obscure points in the evolution of life is the origin of vertebrates, or backboned animals, from invertebrates. Somewhere there came in a new type, with the nervous system on the back side and other new characters, which scientists call "chordates," but still without a *jointed* "backbone." This hypothetical type gave rise to several very lowly relatives of the vertebrates as well as to real vertebrates, with a jointed backbone. The fishes with only a gristly or cartilaginous skeleton gave rise to fishes with bony

skeletons, as well as to fishes with both lungs and gills; and these, through amphibia and perhaps reptiles, to the highest animals. Another illustration: living lizards are nearest the primitive reptiles. But the lizards have given rise to the more specialized reptiles, as well as to birds—a very uniform group.

The "tree" is worth a good deal of study if you will keep in mind that the details of relationship and position of the groups are probable, but in most cases not a matter of scientific demonstration.

Amazing Instances of Animal Behavior

IN ONE of the simplest living creatures we know, we find a sort of mind. As we think of the animal kingdom, it is hard to resist the feeling that animals have learned the mottoes of our copy-books. They seem at first sight to act every day as if they had taken thought for the morrow. They take the line of least resistance. They look before they leap. They know that in union there is strength. They save for a rainy day. They seem to understand quite well that a stitch in time saves nine, and that for everything there is a time and for everything a place.

Think of the spider and its web. The web seems as well thought out as the Statue of Liberty in New York harbor. The spider builds as if it had studied stress and strain like an engineer. It makes one kind of road for itself and another for its victims; it meets the danger of storms by making new runners.

Go to the ant. How many among the millions who trample them to death know the wonderful things these creatures do? They will capture the green aphids that devour our roses, make them prisoners, build galleries in trees to keep them in, milk them, protect their eggs to insure a continued supply, and when new aphids are born the ants will carry them to the plants that aphids live on, and take them back to prison.

The Beaver's "Open Port throughout the Year"

Long before man had built his first bridge the beaver had built his dam; long before man had thought it all out the beaver had arched his dam against the stream and made little sluices. One of the fundamental rules of engineering was working in the world ages before Archimedes. The beaver builds a lodge at his dam and a storehouse for winter. For ages he has solved the problem that so long baffled Russia; frozen in by ice, he seeks and finds a free water gate through which he can receive supplies.

The bees, perhaps the first sanitarians in the world, have established a civilization that excites our wonder. They toil and build and store; they obey the laws and punish those who break them; they live and move and have their being impelled by a patriotism of the hive beyond the dreams of men.

We think of this wonderful behavior of animals and call it instinct. But what is instinct but a sort of

immutable mind, fixed by natural law? A man is lost; he works his way home by the stars, and we call it mind at work. A crab is lost on the Long Island coast; it crawls back a hundred miles to its home in New Jersey, and we call it instinct. We must not deceive ourselves by the words we make. Probably the spider, the ant, the beaver, and the bee do not *reason* as we do; but if intelligence consists in the individual's ability to profit by his own experience, as well as the racial experience which constitutes instinct, we cannot deny intelligent behavior even to the lowest animal forms.

A crocodile taken out of its egg will find its way instantly towards a stream; a frog put in a bag and taken from water will go straight back to water on being set free.

A young eel, unable to develop in the sea, leaves the tidal river and goes far up the inland waters; and when the time comes it returns to the sea to lay its eggs.

The little shellfish called *limpet* has no eyes, but every limpet knows its spot on a rock. It comes down at low tide and goes about and feeds, and it finds its way back infallibly to its chosen dwelling-place.

The nightingale born on an English hilltop flies to Africa; it goes to the right place at the right time, moved by some innermost understanding. It is not driven by hunger, for if it stayed till hunger came it would arrive too late. Cage a nightingale and it will beat its wings against the bars when the time comes to go.

A carrier pigeon will bring a general his dispatches; one has been known to fly from Rome back to its loft in an English town. It took a month, flew a thousand miles, and crossed a range of mountains and 20 miles of sea.

That Wonderful Sense of Direction

A horse will take a lost man home on a dark night; a horse has taken its dead driver home through the busy streets of a great city. A cat, taken a hundred miles in a box, will find its way back to the old fire-side. A St. Bernard dog will find a traveler buried in the snow, dig him out and fetch help.

In the deepest sea we find some form of life; in the lowest life we find some sort of mind. We all know wise animals that seem to act with an intelligence we do not find in some men.

There was in Pelorus Sound, New Zealand, for 20 years a dolphin, protected by the government, that piloted ships through this dangerous strait. As a ship approached, Pelorus Jack would dart from his hiding place and swim ahead, going steadily until he reached French Pass, where he disappeared. He never went beyond, but up to that point no human pilot was ever more reliable than he.

There are cormorants that catch fish for us, chetahs that catch deer; captive elephants that catch and help tame wild elephants. They will do these things for their employers as unfailingly as workmen.

There was a frog that answered to its name when called by Professor Romanes. There were fishes that would answer a bell rung by Sir Joseph Banks. There was a tortoise in Gilbert White's village of Selborne in England which would hobble every morning to meet the old lady who fed it. A crocodile has been known to pine on being separated from its owner, and to spring with delight when he returned.

The Buffaloes and the Tsetse Fly

Everywhere the wisdom of life is manifest in the animal kingdom, and the student of evolution finds himself confronted with facts such as those concerning South African buffaloes in Matabelaland. They used to feed by day, now they come out by night. They have changed their habits since plague destroyed nearly the whole of their race, and it is not impossible that these dumb creatures may have discovered that the tsetse fly which carries the plague germ does not fly by night. There would be nothing incredible in that. Animals act consistently as if they knew.

Could anything be more wonderful than the preciseness of the knowledge of the fairy-fly (*Mymaridae*), the tiniest of insects, sometimes so small that five can walk abreast through a pinhole? The mother finds a larger insect, and lays her egg in its body *exactly when and exactly where the egg of the larger insect is forming*. The larger egg is formed with the fairy-fly's egg inside it, and the fairy-fly's egg produces a grub, which lives by eating the larger egg and then emerges with four wings.

But the examples are beyond all counting. We find them in thousands among horses and dogs. Who has not heard of the bear that will stir the water to bring a piece of bread towards him, or the crow that will drop a mussel on a stone from a height of 90 feet, and seems to choose its favorite stones for breaking victims on? Who put into the head of the eagle the idea of driving out one deer from a herd and frightening it towards a precipice? Who will deny the power of a sort of "thinking-out" to the crow that fetched a companion to help to battle with a dog for its dinner-bone?

The Ant that Sows and Reaps

And what shall we say of the harvest ant, which has the marvelous power of collecting seeds, putting them down in its warm moist nest, where they should naturally start to grow, and of checking their growth till it suits it that growth should begin? When at last

the seeds begin to grow, the harvest ant lets the process proceed until the sugar is formed, and then carries off the sugar to dry in the sun.

We see it everywhere, this deliberate preparation for the morrow. The butcher-bird impales his prey on thorns, and leaves it till he wants it. Squirrels and jays and woodpeckers, like rats and mice and men, lay up stores for the future. Even the rattlesnakes gather into companies for warmth in the long winter sleep, and separate when the need for food comes. They know there is warmth and comfort in company, but that too many rattlesnakes together will impoverish food supplies when they awake. They mobilize at the right time for the right purpose, on the principle which drives many groups in the animal world to defend their own herds against animals that hunt in packs.

If we could speak of affection in the animal kingdom we should hardly expect to find it in wasps and crocodiles; yet allied to their intelligence is something touched with the glow of emotion. The crocodile buries its eggs in the hot sand, comes out and taps the ground, and when the young cry out scrapes the sand away and introduces them to the world. The solitary wasp, living for the future of the race, stores up before it dies food for its unborn that it will never see.

Mother Love in the Animal World

The chapter of natural history which tells of the gallantry of the stickleback and the devotion of the whale in defense of their young is one of the most beautiful that can be written, and it can be multiplied a thousand times. Men waited ages for news of life in the Antarctic regions, and when it came at last it was the old, old story of a mother's devotion to her children. Nothing in the realm of nature is more touching than the wonder of the emperor penguins and their eggs. They stand for weeks during the long Antarctic night with the egg between their feet, keep it warm; and the parents share the patient task between them, faithful witnesses to that mysterious power which reaches everywhere, deep into the innermost, wide unto the outermost.

Many students of animal behavior—especially those who believe in a "mechanistic" explanation for almost all living phenomena—seek to account for many such instances as these on other grounds than the possession of intelligence. In the lower organisms especially, they find the explanation in what are called various "tropisms," or the tendency of living matter to respond definitely to such external stimuli as light, heat, touch, and the like. Thus they explain the behavior of the moth when it flies to certain death in the candle's flame as a response to the stimulus of light. They argue that if one attributes intelligence to the single-celled organisms, we must do the same also for many of the elements of the body, especially the wandering cells that respond to stimuli and move about in the body in much the same ways as independent organisms living freely in nature.

GIANT MONSTERS *of* LONG AGO



ANIMALS, PREHISTORIC. It was hot and stifling in the swamp. From the brackish water the heat-mist rose and swirled slowly over the jungle-like foliage. Great ferns as big as trees held their tracery aloft in the still air; huge palms bloomed heavily, the flowers shining on their trunks; giant horsetails 20 feet tall stood like stiff pillars; and over the mud of the bank great mosses clambered and a tangle of swamp undergrowth steamed. In the warm water aquatic plants grew in masses.

There was no man alive to breathe the stifling air, for man had not yet been born, and would not be for millions of years to come. For this was in the Mesozoic geological age, the "age of reptiles" before even any mammals had been evolved (see Geology). The swamp was in Wyoming, where the highlands are now.

A Nightmare, Sixty-five Feet Long!

In an arm of the swamp, half in the shallow water and half out, a great bulk lay, like a slumbering mountain. Suddenly it began to move, and slowly and clumsily it clambered to its feet and lumbered up the bank, the mud sucking and quaking under its awful weight. It was a creature more strange and terrible

than any dragon seen in a nightmare, a creature 65 feet long and weighing nearly 40 tons, with a huge tail over 20 feet long, a body the size of an elephant's, and a ridiculous little head set on a long heavy neck. It moved slowly away from the bank, pausing now and again to feed on the tops of the fern trees.

But suddenly its small stupid eyes showed signs of alarm. It turned and started at a clumsy run for the shelter of the water. Too late! For another creature had sprung upon it, one of the most terrible hunting

MILLIONS of years ago, in the "Age of Reptiles," the earth was inhabited by animals unlike any creatures alive today. Great stupid Brontosaurus crunched the tops of the dank trees; bloodthirsty and agile Allosaurus preyed upon these herbivorous giants; Pterodactyls of varying sizes, with their batlike wings, coursed the air, while Ichthyosaurs and other "sea serpents" sported in the ocean depths. Fossil remains of these ancient monsters are found imbedded in rocks and soil in many parts of the world, and from these scientists have been able to tell us much of the probable history and habits of these primitive creatures and to reconstruct their forms for our museums of natural history.

creatures that has ever lived. It was not so large as its prey, though it was 34 feet long, but it was much more agile. It leaped and ran on two great hind legs as a bird runs, and its three-toed feet were armed with strong claws. Terrible teeth were in its great head and a blow from its powerful tail was a deadly

thing. Only its front legs, like tiny arms, were weak and almost useless.

With a snort of rage, it leaped upon the stupid and terrified giant, and, seizing the great neck between its teeth, it crunched through the spinal column. The giant crumpled, shook convulsively, and died. Then the hunter settled down to a feast. For a long time he gorged, then he slept.

As he slept a tremor shook the mud bank of the swamp. The earth quaked and trembled, and the spot where the hunter and his victim lay sank and was

WHEN MONSTER ATE MONSTER



The artist has here pictured the scene where the monster with the long neck and the little head—a huge vegetarian Brontosaurus—is about to be attacked by another monster, the Allosaurus, who made it the business of his life to have certain of his fellow monsters for dinner every so often. The Allosaurus, as you see, was not so large as its prey, but much quicker in movement. It stood on those great hind legs and braced itself with huge tail, as it prepared to spring upon its prey. These two creatures belonged to the great Dinosaur group of reptiles, and they lived thousands and thousands of years ago, but their fossil bones have been discovered, and so sharp are the eyes of science that from these we are able today to make pictures like this one which show us how they looked and how they lived.

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covered by an avalanche of mud, engulfing the two, so that the hunter lay as dead as his prey. Ages passed, millions of years, no one knows how long. The swamp was heaved up into a high plateau. Man appeared and grew to civilization.

Where You Can See These Monsters Today

And then one day the petrified skeletons of the two monsters were found, the teeth marks of the hunter still in the spine of the victim, and men dug them out and marveled at them. For this is no fairy story. You can see the two today, or at least their skeletons, mounted in the Museum of Natural History in New

There were many different species of these prehistoric monsters, all now given scientific names almost as terrifying as they were themselves! There was Tyrannosaur, much like Allosaur, but bigger and more terrible if possible, and Megalosaur, a near relative. These were meat-eating. Among those which fed on vegetable matter were Diplodocus, who might have been a brother of Brontosaur except that he was bigger yet, being 87 feet long; Trachodon, who had a wide snout like a duck-bill and 2,000 teeth in his mouth; Iguanodon, whose tail was flat so that it could be used for swimming; Stegosaur, who had as much armor as

THE MONSTER WITH THREE HORNS



This is another one of the Dinosaur group, known as Triceratops, on account of his three horns, the name being from two Greek words meaning "three-horned." Two of the horns you can plainly see in the skeleton. The third was shorter and grew out of the end of his nose, as shown in the picture on the opposite page.

York City, just as they may have been when the hunter held his feast.

These two creatures belonged to the family of Dinosauria, the largest land animals that have ever lived. The giant was called Brontosaur, and the hunter Allosaur. They were reptiles, and though they have no very near relatives living today, they were related to the crocodile, and, strange to say, to the birds. For it seems certain that the birds developed from some early reptile.

Like the reptiles of today these huge beasts were probably cold-blooded, and it is supposed that they laid eggs. They were extremely stupid for all their strength, and even Allosaur could hardly make a living were he alive today when animals are quicker and more intelligent. But in the "age of reptiles" they were lords of the earth, and they ranged over Europe, North and South America, Africa, Australia, and Madagascar.

a small warship, with great plates that stuck up from his spine and heavy spikes on the end of his tail; Triceratops, perhaps the weirdest beast of them all, with an enormous head which with its neck-frill of bone was eight feet long, and had three horns on its face. The smallest of them was about the size of a cat, and Diplodocus, with his 87 feet of length, was the largest.

The Dinosaurs were land animals, but in that age the sea and air also had their monsters. In the air the Pterodactyls were lords. They were reptiles too, and curious creatures they must have been! The smallest ones, which were also the earliest, had a body not much larger than a sparrow's, though the spread of wings was greater. From this the Pterodactyls ranged in size to Pteranodon, the largest creature that has ever flown. The earlier species had teeth, but these great flying lizards had no teeth, but instead a very long dagger-like beak.

MR. TRICERATOPS IN HIS NATIVE WILDS



Here, thanks to the magic of the artist's brush, the picturesque creature with the three-horned face has come back to life and we see him in his native wilds in Wyoming. In his day Wyoming had a tropical climate, with tropical vegetation such as you see here. Note how the big bone collar stood up on the neck of this 25-foot reptile. It protected him in his quarrels with others of his family, for although the Triceratops was a vegetarian, as shown by his teeth, the males fought each other.

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The Oddest of All Flyers

Pteranodon was so curious looking that one would almost have to see him to believe in him! He had a spread of wing of over 20 feet, a small stumpy body which probably did not weigh more than 25 or 30 pounds, an enormously long skull from the back of which protruded a long bony crest—the skull with the crest was nearly four feet long—and huge batlike wings composed not of feathers, but of a membrane or skin, that stretched from his legs to his body and was supported by his little finger-bone, which was two feet long. He had no tail, and in flying he apparently steered with the crest of his head and his legs.

On the wing, the Pterodactyls must have been very agile, but on land Pteranodon must have been quite unable to move, and probably rested hanging batlike from the cliff by his fingers and toes. It is supposed that they laid eggs, and small eggs at that. Their food was fish and probably small flying things. They had no feathers, and were probably scaly like the other reptiles.

Strange Creatures of the Sea

The sea sheltered equally strange creatures in this Mesozoic age. Ichthyosaurus, who according to the limerick "fainted with shame when he first heard his name, and departed a long time before us," is perhaps the best known genus. The Ichthyosaurs looked not unlike whales, though they were really reptiles and their inner structure is quite different from these mammals. Their bodies were round and tapering, their heads large with long snouts and very short necks, their limbs had turned into small paddles, and they had a tail with two points, the spine extending into the lower point. They brought forth their young alive, for a specimen has been found containing bones of several young. When full grown they were sometimes 40 feet long.

Just what caused the end of all the weird reptiles of the Mesozoic age is not exactly known. But at the end of this age great upheavals of land took place in many parts of the world, especially North

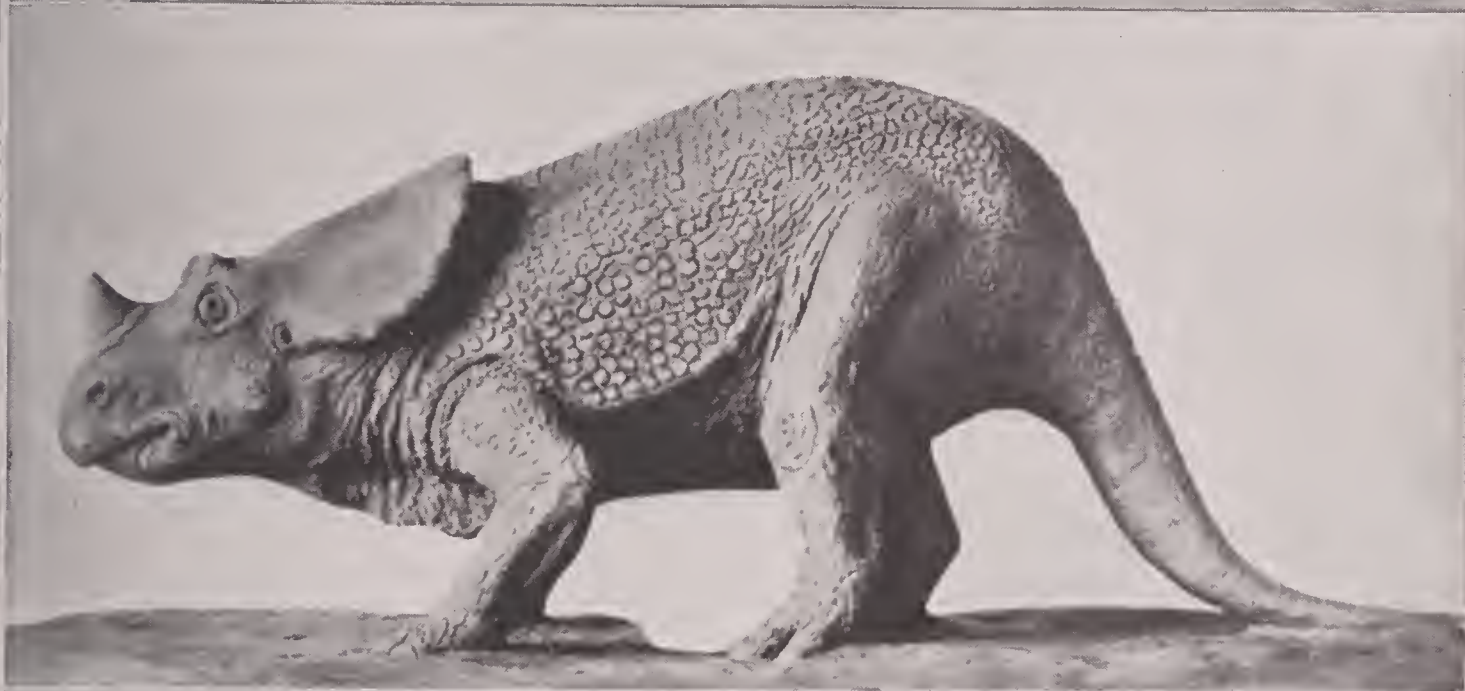
America. Huge mountain ranges rose, and many of the swamps were raised into high and dry plateaus; and the climate grew colder and the vegetation changed in character. The Dinosaurs and the other reptiles, being cold-blooded and feeding on tropical vegetation, could probably not adapt themselves to this new mode of life and so died. Thus the way was left

WHEN NATURE WAS PUTTING IN HER COAL SUPPLY



In the age when the great forests of giant ferns grew, which afterward turned into coal, what is now the temperate zone was very hot—tropical, in fact—and the monsters, who dearly loved hot weather, were just in their element, as you see by the example of the two creatures who are swimming about in this pool in one of the great carboniferous swamps.

THREE UGLY MEMBERS OF THE DINOSAUR TRIBE



Here are three of the strangest monsters that ever lived. The one at the top is called the Stegosaur. The bony plates on his back protected him against the deadly leap of the flesh-eating Dinosaurs, while the sharp spines on his powerful tail were probably used to slash the foes that crept upon him from behind. The creature in the middle belongs to the Ceratopsia group—an ancestor of the Triceratops, shown in the earlier pictures, who had not yet developed the two long horns on his forehead. At the bottom is one of the carnivorous Dinosaurs killing and eating one of his smaller cousins.

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clear for the development of the next great series of animals, the mammals.

Although these monster reptiles are perhaps the most startling creatures that ever lived, the remains of countless animals which existed before them and after them in prehistoric times have been dug out of the earth (see Fossils; Mammoth and Mastodon).

One of the most striking things in the review of these remains is that nature seems to have tried out nearly all types of animals in nearly all sizes from pigmies to giants. Thus a dwarf elephant has been found no bigger than a dog, and a giant dormouse larger than a cat. Remains of beavers as big as bears have been discovered, and sloths 18 to 20 feet long have been found. Fossil dragon-flies measuring two feet across

This picture shows you how the monsters whose skeletons we see in museums are restored—the missing portions of the bones being modeled in plaster. The artist is here at work on the skull of a duck-billed Dinosaur. Long and careful study is necessary before the scientist attempts to rebuild these ancient skeletons.



the wings have been dug out of the coal beds of France. The rhinoceros group seems to have been one of the favorite types for experiment, for some had no horns at all, some had as many as four and five, others had tusks like the walrus. Tusks and horns were indeed distributed freely by nature in bygone days, remains of even such animals as gophers having been found with horned noses.

Among the most interesting fossil discoveries is that of the primitive bird called *Archaeopteryx*, which is clearly a connecting link with the reptiles. About the size of a crow, it had no beak, but its long jaws were armed with teeth. Unlike all living birds, it had three sharp-clawed fingers on each wing, and a long bony feathered tail.



It is in this shape that the bones of prehistoric animals arrive at the great museums, such as that of the American Museum of Natural History in New York, in which this picture was taken. The bones are imbedded in rock because the mud in which the carcasses of dead monsters were originally buried has turned, in the course of the ages, into stone. The stone is carefully chiseled away—you notice that the man on the left is working with a chisel—and then the expert who has spent his life studying thousands of such fossils looks over the bones carefully and decides to what ancient creature they belonged.

For any subject not found in its alphabetical place see information

ANNAPOLIS, MD. The quaint capital of Maryland is on the Severn, about two miles from its entrance into Chesapeake Bay. It was named after Princess (later Queen) Anne of England. Settled in 1649 by Puritan exiles from Virginia, it was noted in colonial days for its social and intellectual life. The United States Congress was in session in the tall-domed State House from November 1783 to June 1784. Here, on Dec. 23, 1783, Washington resigned his commission as commander-in-chief of the Continental Army; and here, a year afterward, the treaty of peace with England was ratified. Annapolis has been the seat of the Naval Academy since 1845 (see Naval Academy). Population, about 9,000.

ANNE, QUEEN OF ENGLAND (1665-1714). What pictures of stately, dignified, quick-witted womanhood the word "Queen" brings to mind! Unfortunately Anne, who was the last of the Stuart rulers of England, falls far short of our pictured ideal. She was so dull, slow, and obstinate, that it has been said that there was "only one person in the kingdom more stupid than she—and that was her husband, Prince George of Denmark." Queen Anne was, however, pious and good-hearted; she served the state to the best of her ability and undoubtedly deserves the title

of "Good Queen Anne." But she had strong prejudices and was easily influenced by her friends. John Churchill, who rose to be Duke of Marlborough and commanded the English armies in the victory at Blenheim, and his beautiful but imperious wife Sarah Jennings, were among Anne's intimate advisers during the first part of her reign.

Anne was the daughter of James II, against whom she supported William of Orange when he came to the throne of England as a result of the "Glorious Revolution" of 1688. She succeeded her brother-in-law William in 1702. Her reign (1702-1714) was marked by the War of the Spanish Succession, which brought an important increase in British seapower, by the parliamentary union of England and Scotland (1707), and by the activities of such brilliant writers as Addison, Pope, Dryden, Swift, and Defoe.

Anne was a devout Protestant while her exiled father and his son the Pretender were both ardent Catholics. In her reign a law was passed providing that the crown of England, after her death without direct heirs, should pass to the nearest Protestant branch of the Stuart family. It was this Act of Succession which brought King George I of the Hanoverian line to the British throne in 1714.

The MARVELS HIDDEN in an ANT-HILL

THE great naturalist Linnaeus once said: "Nature is most marvelous in the smallest of her creatures." The more we study the ways of the ant,—and we still have much to learn—the better we understand what Linnaeus meant. Ants live in highly organized communities. They are builders and miners, farmers and warriors and slave-holders. They keep herds of "cows"—still tinier insects, the aphids—which they milk skilfully to obtain one of their favorite foods. They can distinguish friend from foe almost instantly, and have mysterious ways of passing news from one to another. They tend their young with great care and devotion.

ANT. The life story of the ant reads like a fairy tale. So wonderful is the way in which ants live together in colonies, so intelligent are their methods of building their homes, dividing their labors, obtaining food, and conducting their wars, that some observers have thought that these insects actually are able to reason. Lord Avebury (Sir John Lubbock), a great scientist who spent years studying the ants, said: "It is difficult altogether to deny them the gift of reason. Their mental powers differ from those of men not so much in kind as in degree."

There are more than 2,000 species of these amazing little insects, of which about 200 are found in the United States. The most common are the *red ants* and *black ants*, which you so often see—slender-waisted little creatures with six legs and two long slender antennae, which are



Yes, she just rose from her slumbers a few moments ago, and is making her toilet; not, however, doing up her back hair, but the next thing to it—for she is combing her antennae, to clean them.

constantly waving to and fro as the ants move about. Their bodies are divided into three very distinct regions: head, thorax, and abdomen. The head bears the antennae or feelers, by which the ant smells and feels its way about, recognizes and communicates with other ants, and finds its food. It also bears powerful jaws for biting and carrying objects, and eyes sufficiently developed to recognize light and darkness, although some ants are blind. Some ants also have stings from which they eject a powerful poison called formic acid.

All ants are social insects, that is, they live together in large groups—sometimes hundreds of thousands—like the bees. These communities are much like little nations, with their queens, their winged males and females, and their wingless workers and nurses. In some colonies the

THE BLACK ANT'S HOME AND THE WINGED QUEENS



On the left is a picture of a black ant's nest which has been uncovered to show the chambers and passages in the wonderful little apartment house underground. On the right are queens with their wings on; so you may be sure that they have not yet gone to housekeeping and settled down to the cares of family life.

workers are divided into large and small workers and soldiers. The soldiers have large heads and more powerful jaws and protect the home colony against its foes.

The Ant Colony and Its Queen

An ant colony is started by a single female which leaves the parent community at the swarming time, and lays her eggs which hatch into maggots similar to fly maggots. She feeds the young ants or larvae from her own body until they spin their cocoons and pass into the *pupa* stage, from which they emerge after several weeks. These worker ants now take over the duties of the colony and wait on the queen, so that she can spend all her time in egg-laying. Since this first brood of ants has been very poorly fed, it is smaller in size than the later broods, which are abundantly fed and tended by their small older brothers and sisters. If you watch an ant-nest carefully you can often see the workers carrying the tiny maggot-like larvae and the cocoons of the pupae out into the sun to hasten their growth, and then back to the underground chambers.

After the queen ant has produced a large number of workers, she at last lays eggs which hatch into a brood of males and females with wings. These are tended and fed with the utmost care by the workers, until they are ready for the marriage flight some sultry

THE QUEEN AND HER LADIES-IN-WAITING



Of course you know that's the queen in the center, but what do you suppose that little lady-in-waiting is doing to Her Majesty? Perhaps she's giving her a pinch to remind her that there is no use of her trying to get away; for the queen is only a limited monarch after all and is kept closely confined by her bodyguard in the nest.

day. In places where there are many ant colonies they come out in myriads and fill the air. After the wedding flight, the females enter the ground to make new nests and form new colonies, except for those who are captured by the workers and dragged back to their old homes to replenish the parent colony. Having no more use for their wings, the females pluck them off, and spend their remaining life—which may be as long as 17 years—underground. But the unhappy winged males have no such long life ahead of them. Their work is done, and the industrious workers have no more use for them. They are not allowed to return to the parent colony, from which they emerged for their few brief hours of glory, and soon fall prey to birds or spiders or perish in some other way. The law of ant life is inexorable: Work or

die. In some colonies the workers kill the old members as soon as they become too feeble to work.

For their nests or *formicaries*, many kinds of ants build marvelously complicated structures. Most nests are many-storied labyrinths of galleries and chambers, extending for several feet or even yards underground. The mound-building or mason ants rear great structures sometimes 3 feet high and 12 feet in diameter. Other ants are carpenters, cutting long tunnels and galleries in dead trees, while some pile up great heaps of leaves and twigs to build their homes. Some of

THEY'RE ALL MAKING THEIR TOILETS



Here are a number of other ants engaged in making their toilets, just as the ant is doing on page 139. But while that ant is cleaning her antennae, two of the ants here shown are cleaning their legs and stinging organs, while the third is cleansing its abdomen with four of its legs while hanging by the other two.

the chambers in these complicated colonies are used for sleeping during the winter, others are used as nurseries for the larvae, and as storerooms for food and stables for their "cattle"—the aphids or plant lice (*see* Aphids).

Ants eat many kinds of animal and vegetable food, but they like nothing better than the honey produced by the plant lice or aphids. Since the aphids are soft defenseless little creatures, an easy prey for other insects, the shrewd ants take various measures to protect them. Sometimes they carry the aphids into their colonies and feed them there on the food they like best. More often the ants guard small groups of the plant lice, protecting them from their foes, carrying them from withered plants to fresh vigorous plants, and from one sort of plant to another kind more favorable to their honey-making.

THE PARASOL ANTS



This is a procession of so-called "parasol" ants carrying leaves on their way to their underground homes. They are not carrying the leaves as parasols at all, but are taking them to their gardens for use in raising mushrooms, as explained in the text.

OUCH! OH, THOSE TERRIBLE DRIVER ANTS!



Can you imagine it! Not only the timid antelopes, but the powerful elephant and the horned rhinoceros and the tiger and the terrible gorilla, are crashing their way through the jungle as fast as they can, fleeing—from what do you suppose?—a little bit of a creature no longer than your thumb nail—the driver ant! They are undoubtedly making for the water to drown their savage and remorseless enemies. It's the only thing they can do, you see.

Some South American species of ants form "mushroom gardens" in their chambers below the ground, cutting and carrying to these special quarters large quantities of leaves. These leaves soon become a fertile field for a mold or fungus which the ants then make their only food. Others gather large stores of grains. Some species gather honey from flowers, which is preserved in a remarkable fashion. Some of the workers remain within the nest, suspended by their feet from the roof of the chamber, while other workers forage for honey and pour it into the mouths of these living "honey pots." From time to time the "nurse" workers draw out from them the supplies to feed the young. Other habits are equally remarkable.

In some hot countries, like the central parts of Africa, South America, and southern Asia, there are species of ants which are flesh eating, and which capture live creatures for food. In West Africa these ants are called *driver ants*. Such ants are very much feared, for they hunt in long columns of millions of individuals and are as savage as tigers. The largest and fiercest animals are helpless before them and perish under the millions of bites, unless they can

flee to water and drown their tormentors. Animals confined in pens will be killed and devoured in a few hours. In Africa when a swarm is seen approaching, the people all leave their houses and let the ants clear out any insects which they may find there, as well as the rats and mice.

A FRIEND IN NEED



This shows a little group of worker ants drawing rations of honey dew, as it is called, from an ant that has been milking one of the aphids, or ant cows, and has more than she can comfortably carry in her own stomach.

Some kinds of ants, like the Amazon or *warrior ants*, actually keep slaves. They go out in great armies on expeditions against smaller kinds of ants, drive them out of their nests, and carry off their eggs and larvae and pupae to their own nests, as well as their stores of food. The captured eggs, larvae, and pupae are carefully tended, and when they grow into ants they are made to work for their captors. Some of the robber-ant communities do no work at all for them-

selves, and live wholly on the food captured from other colonies and collected by their slaves. They thus become so helpless that if their slaves are taken away they perish miserably. In a robber-ant community the soldiers are of two sorts, large and small, and on the march the small soldiers are drawn up in a long narrow column, while the large soldiers are scattered along both sides and appear to act as sentinels and officers.

SKY-SCRAPERS OF THE TERMITE WORLD



While the homes of all ant communities are very remarkable in their architecture and their domestic economy, none are quite so striking in some respects as the hills of the termites, or so-called white ants. This picture shows a cross-section of one of these sky-scrappers of the termite world. The divisions of the structure are here made more precise than they really are, so that the architecture, the provisions for ventilation, and the like, may be more clearly understood. As the text tells you, these sky-scrappers are sometimes 25 feet high; this picture of the native African beside one of them enables you to get a good idea of its size. But more remarkable than its size—which is wonderful enough, when you think what little creatures made it—is the skill in architecture and domestic engineering shown in its building. Near the roof, you see, is the nursery. Ventilation is so important that the entire cupola is devoted to that purpose, and on either side are also ventilating spaces admitting fresh air from the outside. Below the nursery and between the supporting pillars are additional stores of fresh air. At the very bottom is the royal chamber of the king and queen, while around it are the quarters of the termites who spend their lives as the royal body servants. With so many mouths to feed—there are often more than 2,000 residents in one of these structures—there must be large supplies of food in the larder; and you see plenty of storage space has been provided. In wet weather all this food would be spoiled, like the good things in a flooded cellar, if these wonderful little people hadn't thought about drainage. But you see they did!

The Dreaded Termites of the Tropics

The so-called "white ants," which are so much dreaded in hot countries for their ravages, are not true ants and are rarely white, so they should be called by their proper name, *termites*. They are larger than ants and have terrible jaws, which enable them to bite through clothing and inflict a painful wound. Like the true ants the termites live in colonies, with kings and queens, workers and soldiers; and they build enormous domed mud dwellings, sometimes 25 feet high and so strong that they will support the weight of cattle. The queen termite grows to huge size, often five or six inches long, while the average size of the others is from half to three-quarters of an inch. The termites are especially fond of woody matter,

and in the tropics they do great damage by gnawing out the interior of wooden furniture, door and window sills, and other objects of wood, leaving only the outside shell.

Anyone who wishes to study the fascinating habits of ants may do so with little trouble at home. Take a round jar made of clear glass, fill it three-quarters full of moist earth gathered from a field or garden. Make a cylinder of thick dark paper which will fit snugly around the jar to the height of the earth inside. This must be of such diameter that when you hold the jar by the top the paper tube will easily slide up and down the jar.

Now find an ant colony and capture as many ants as possible, taking care not to injure them. Dig out

THE VAST ANTARCTIC CONTINENT AT THE SOUTH POLE



The South Pole lies at the heart of a huge desolate ice-capped continent as large as Australia, in contrast to the North Polar regions, which are a wide shallow hollow in the earth's surface filled with the ice and waters of the Arctic Ocean. Behind the walls of ice that everywhere encompass the Antarctic continent, the rocky shores rise in most places to sheer heights of 4,000 feet, while the center of the continent is a plateau 10,000 feet above sea-level. Notice that although the tip of South America is much nearer to Antarctica than South Africa or New Zealand, the route taken by Scott and other explorers was from the New Zealand side. This is because the Ross Sea there cuts deep into the continent, greatly shortening the land distance to the Pole.

For any subject not found in its alphabetical place see information

their nest and get their grubs and cocoons, and if possible capture a queen ant, easily recognized by her greater size. Carry your prisoners home and put them in the jar with the earth. If a fruit jar is used do not put on the lid; the top should be covered with paper, into which small holes have been punched with a pin to let in the air. If the jar is left in the sunlight and not disturbed, the ants will at once start building a new home, tunneling particularly along the sides of the jar. From time to time food should be placed in the jar—a little sugar, small bits of cooked meat, dead flies, etc.—and a few drops of water should be sprinkled over the earth from time to time to keep it moist.

After a week or so, draw off the paper cylinder. You will be amazed to discover a network of tunnels, plainly visible alongside the glass, through which ants are hurrying about their work. Do not leave them exposed to the light too long or the ants will burrow out of sight into the center of the jar.

Ants (*Formicidae*) belong to the order *Hymenoptera*, which also includes the bees and the wasps. The common black ant of the United States is the *Monomorium minutum*; the little red ant, sometimes called Pharaoh's ant, which infests houses, is the *Monomorium pharaonis*. The common "white ant" found in eastern parts of the United States is the *Termes flavipes*.

ANTARCTIC CONTINENT. Who would have imagined a few decades ago that there remained another great continent to be discovered? Who would have dreamed that the ice-bound waters of the Great Southern Ocean surround an island-continent as large as Australia? Here and there explorers had come upon land in these unknown waters, but geographers generally believed that these lands were islands. They pictured the South Polar regions, like the North Polar regions, as a vast expanse of frozen sea, holding in its icy grip a few scattered islands and archipelagoes.

Today, thanks to the fearless labors of recent explorers,—some of whom perished dauntless at their task—we know that the South Pole lies almost at the center of a circular continent which stretches away in every direction nearly to or beyond the Antarctic Circle.

A Land of Desolation

No other region on earth is like this desolate ice-capped land of Antarctica. Howling gales which blow so hard that a man can hardly stand against them perpetually sweep down from the Pole and make the land uninhabitable except for the few hardy sea-birds and sea-animals that visit its shores. Penguins, petrels, and a few other Antarctic birds nest on its sun-exposed cliffs in summer. Seals, sea-lions, and sea-elephants occasionally emerge from its waters to rest on the fringes of ice that surround it. But the interior of Antarctica is a land of death. There are no land-mammals—no polar bears, no foxes, no wolves, no hares. And only the hardiest plants, such as mosses, lichens, and hepaticas, cling during the brief summer to the few exposed bits of soil and rock.

For nearly its whole extent the continent is covered with a prodigious sheet of ice, 2,000 feet thick in places, which has existed since a time before the first man of the old Stone Age appeared on earth, in the long distant past. Many fearful chasms split this ice-cap, sometimes covered over by a treacherous coat of thinner ice and snow, thus luring unwary explorers to a living tomb. The shores in most places rise precipitously some 4,000 feet from the ice belt that everywhere encompasses it, and in the interior gigantic mountains thrust their icy masses high into the air. The whole central plateau, in the midst of which lies the South Pole, is more than 10,000 feet above the sea, and it is surrounded by a chain of peaks rising to 15,000 feet or more—higher than any mountain in the United States south of Alaska.

Approach to the shores of the continent is everywhere made difficult by a wide belt of frozen ocean. In summer this breaks up into floating pack ice which often extends for hundreds of miles from land. Through this pack ice the stout ships of the explorers must buffet their way for days before reaching the towering ramparts of everlasting ice which girdle the whole continent. In many places this gigantic ice barrier rises far above the masts of the tallest ships. In other places it is so far worn down that it is used as a convenient dock alongside of which explorers moor their vessels.

An Ice Wall 400 Miles Long

Between Victoria Land and King Edward VII Land, on the side nearest New Zealand, the coast is broken by a great gulf larger than the states of New York and Pennsylvania. Here the Great Ice Barrier, or the Ross Ice Cap as it was named in honor of its discoverer, rises from the ocean in an unbroken series of cliffs from 100 to 400 feet high and extending for nearly 400 miles. For days and days intrepid explorers sailed along this forbidding barrier before they found a place where landing was possible. Nevertheless, because the distance to the Pole is less here than elsewhere, the Great Ice Barrier has been made the starting point for all expeditions into the inhospitable heart of the continent.

The enthralling story of how parts of this frozen continent were explored, and how the Swedish scientist Amundsen and the English Captain Scott reached the South Pole, is told in the articles on Polar Exploration, and Scott, Robert Falcon.

From the tip of South America to the nearest known part of the Antarctic Continent the distance is 500 miles; from New Zealand, 1,600 miles; from Australia, 2,000 miles; from South Africa, 2,300 miles.

ANT-EATER. This toothless mammal is found chiefly in Central and South America, where it feeds on white ants and other insects. The long flexible tongue, covered with sticky saliva, is protruded among the insects and suddenly withdrawn when a number have collected upon it. There are a number of species. One species, the *aardvark* or earth-pig, is found only in South Africa. The *great ant-eater* is about four feet long with a large plumelike tail

covered with bushy hair. The color is gray, marked by a band of black on the breast and toward the shoulders; the feet and forelegs are white. The claws are long and strong, adapted for digging open the ant's nest. It sleeps a great deal and lies curled up with its tail spread out to protect it from sun and rain. In defending itself it makes good use of its strong forearms.

ANTELOPE. These widely distributed animals belong like the deer to a group between cattle and goats,



The Great Ant-eater on the ground is rooting about in the New York Zoo for unwary insects to pick up on the tip of his long flexible tongue. This is one of the times when he didn't happen to be asleep, with his big bushy tail spread out. His smaller cousin, known as the Lesser Ant-eater or the Tamandua, has climbed as high as he could, from force of habit, for in his native jungles he lives in the trees. Note the long monkey-like tail that aids him in climbing.

and are the fleetest as well as the most beautiful and graceful of quadrupeds. On the deserts of Central Asia antelopes have been known to attain a speed estimated at 60 miles an hour, easily distancing an automobile going 40 miles an hour. Their horns, unlike those of the deer family, are ringed and hollow and are not renewed annually. The different types vary greatly in size, the pygmy antelopes of South Africa being only eight or nine inches in height, while the largest kinds are from five to six feet. Antelopes are found in Europe, Asia, and Africa, as well as America.

Two kinds are peculiar to North America—the *Rocky Mountain goat* and the *pronghorn*. The former as a rule is found in the mountains just above the timber-line, in high inaccessible spots where only the boldest hunter can follow. In appearance it is clumsy, but it is remarkably agile and is an expert in climbing rocks and icy steep. Its weight is about that of the common deer. The body is thick-set, legs stocky, hind-quarters low, shoulders high, head carried low. The dense coat is all yellowish white, the hair next to the skin being fine and the outer hair long and coarse. The Indians used to make blankets of the long silky hair. The horns are small, black, smooth, and sharp-pointed. It is found sparingly in Alaska and British Columbia, in Idaho, Montana, and Washington, but the well-beaten trails tell of great numbers that once existed.

The *pronghorn*, on the contrary, is a plains antelope, though it stands apart from the true antelopes owing to the fact that it sheds the outer sheath of its horns annually; there is an interior bony core, however, that remains permanent. The pronghorn ranges from the Mississippi River to the Pacific and from a little north

of the Canadian boundary southward into Mexico. At one time there were immense herds in the San Joaquin Valley in California and the species is still abundant in northwestern Mexico. The pronghorn stands about three feet high at the shoulder and is of a bright fawn color marked with white.

The common antelope found in India and Eastern Asia is about 2½ feet high at the shoulders, with erect diverging horns bent in a spiral form. It is so swift that greyhounds cannot catch it, and it leaps easily a height of 10 or 12 feet, while the length of its bound is often 10 or 12 yards. The Chinese antelope is found in the deserts of Central Asia. Its flesh is very much prized. The *gazelle* of North Africa was known to the ancients, its beautiful black eyes being often

spoken of by Arabian poets. In the Alps we find the *chamois* and in South Africa the *eland*, the largest of all antelopes. The *springbok* or springbuck, a species found in Africa, gets its name from the great leaps that it makes. Other members of the antelope family are the gnu, with its curiously twisted horns, the reedbuck, the waterbuck, the steinbok, all natives of Africa, and the Indian nilgai.

Scientific name of the pronghorn, *Antilocapra americana*; of Rocky Mountain goat, *Mazama montana*; of the common antelope or blackbuck of India, *Antilope cervicapra*; of the common gazelle, *Gazella dorcas*.

ANTHONY (ăn'to-ny), SUSAN BROWNELL (1820-1906). During the 1854 session of the New York State legislature, a school teacher appeared in Albany to present a petition signed by 28,000 persons for better laws to regulate the liquor traffic. A member of the Assembly said, "Who are all these signers? Nobody but women." Nobody but women—mothers, wives, daughters, sisters who wanted to protect their protectors against evil habits that threatened the home! The teacher as she turned away said: "A woman's name on a petition will never be as good as a man's until she has a vote."

From that day Susan B. Anthony—for that was this teacher's name—was a woman suffragist. For the next half century she gave every day, every dollar, every power of her mind to the work of improving the position of women, and especially to the work of winning for them the right to vote.

Miss Anthony was first awakened to the injustices which handicapped the women of her day when she began to teach for \$10 a month in a position for which a man would have been given \$40. Her voice was

MEMBERS OF THE FLEET-FOOTED ANTELOPE FAMILY



The Pronghorn antelope of the American plains and a baby Pronghorn. Usually horns are present only in the males, although sometimes well developed in the females. The fawn, who was born in the spring, will begin to develop horns about the middle of summer.



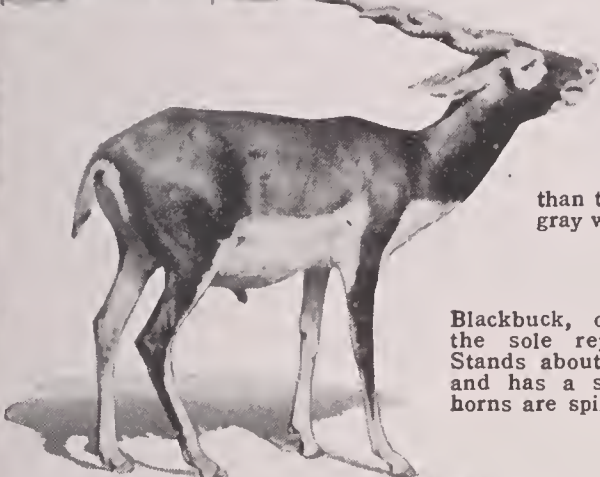
Roan, or Sable antelope, a native of Africa. The neck is covered with a distinct mane, the tail is rather short and has a tuft at the tip. The females have horns, but they are much smaller than those of the males.



This is the Red Waterbuck which lives in Southern and Eastern Africa. It stands about 3 feet at the withers, and its horns average about 28 inches long, although they may reach 3 feet. He wears a long coarse grayish roan coat.



The Nilgai is the largest of the antelopes of India. Only the males are horned. The tail is tufted and the throat of the male has a small tuft of hair. The Nilgai is peculiar in having the forelimbs longer than the hind pair. The color is dark gray with a bluish tinge. Nilgai is Indian for "Blue Bull."



Blackbuck, or Indian antelope. It is the sole representative of its genus. Stands about 32 inches at the shoulder and has a short compressed tail. The horns are spiral, and the turns vary from three to five.



The little Dorcas gazelle stands only about 24 inches at the shoulder, but, my, how it can run! It skims the ground like a bird. It is found in the deserts of Egypt, Algeria, Syria, Palestine, and parts of Asia Minor.



This is the doe of the Blackbuck family. As you see, she has no horns; although some occasionally do have very small ones. Both the does and young bucks are yellowish fawn on the outer sides of the limbs and white on the under parts.



The Rocky Mountain goat, although he looks so unlike an antelope, belongs to the antelope family. He is found in the mountains of western North America.

THE BRAVE BATTLE FOR WOMEN'S RIGHTS



Here we see Miss Anthony, who was one of the first to raise her voice for "Votes for Women," struggling to obtain the right to speak in a state teachers' association of which she was a member and two-thirds of whose members were women. Only after a half-hour of hot discussion was her right conceded by the men. In temperance meetings and other similar gatherings there was at that time the same attempt to "gag" women and prevent their having any part in public affairs. The presiding officer in this picture, who appears so fine in full dress blue coat with brass buttons, was Dr. Charles Davies, professor of mathematics in West Point Military Academy.

For any subject not found in its alphabetical place see information

heard at a meeting of the New York State Teachers' Association in a demand for equal pay for men and women. In 1851 she met Elizabeth Cady Stanton, and this was the beginning of a lifelong friendship and a united struggle for women's rights. At first they organized conventions in the interest of the temperance movement, but they soon became convinced—by the experience narrated above—that women must have the vote in order to make their efforts count. In 1869 Miss Anthony helped to organize the American Woman Suffrage Association, of which Mrs. Stanton was elected president, while she herself became chairman of the executive committee. In 1890, after this organization had united with the Woman Suffrage Association, under the name of the National American Woman Suffrage Association, Miss Anthony was elected vice-president-at-large. In 1892 she followed Mrs. Stanton as president, holding this office until the age of 80; she then resigned and was succeeded by Mrs. Carrie Chapman Catt.

In 1872 Miss Anthony voted in the presidential election to test her status as a citizen. For this act she was tried before the courts of New York state and fined \$100, but refused to pay it, declaring that "taxation without representation is tyranny," just the same as it was a hundred years before.

As the most original and aggressive of all the leaders in the suffrage movement, Miss Anthony was singled out for ridicule. But there are few today who will deny the debt that women owe to her for their privilege of working at almost any occupation, for their right to control their own property and children, for their opportunities for higher education, and for the ballot. When the Woman Suffrage Amendment to the Federal Constitution was submitted by Congress in 1919, it was in the language of Miss Anthony and it is known as the "Anthony Amendment." (See Women's Rights.)

ANTHROPOL'OGY. The name of this science is derived from the Greek *anthropos*, meaning "man," and *logos*, meaning "science." In its widest meaning, therefore, the science of anthropology covers the entire field of man's history—his physical structure, his habits and customs, his language, his arts, religions, and material civilization, and his distribution over the face of the earth. In this sense anatomy and physiology, psychology, ethics, and sociology, and a score of other subjects are closely associated with anthropology. But for practical purposes, anthropology has been limited to a much narrower field.

Man's place in nature or the *zoölogy* of man is the first problem of anthropology. What are the bodily characteristics that distinguish man from monkeys and other animals, and are responsible for his habit of standing on his hind legs and for his other peculiarities? How does the skull of man compare with that of a chimpanzee? Questions such as these are asked by anthropologists in the effort to trace the connection between man's physical qualities and his development and civilization.

The next step is the study and classification of the various races of man. This is called *ethnology*, from *ethnos*, meaning "race." This subject deals with the physical differences between the white and the black races, between the American Indian and the Chinaman. It compares the skeletons and skulls of prehistoric men with those of modern types. It deals also with the customs and religions of various tribes and peoples, their arts and languages—all with a view to finding out how the races differ and how they developed.

A special branch of anthropology is called *anthropometry*, from the Greek word *metron*, "a measure." It is the science which deals with the physical measurements of man, the height and weight of various races, the shape of their bones, and other bodily peculiarities. It is this science which has determined, for instance, that the average height of all men is 5 feet 5¼ inches; that the tallest men are the Polynesians, who live on the small islands of the Pacific Ocean, and who average 5 feet, 9½ inches in height; and that the shortest, outside of certain very rare tribes, are the "black fellows" of Australia, who average 4 feet 4¾ inches. The average heights of other races and nationalities are: Scotch, 5 feet 8¾ inches; Irish, 5 feet 7½ inches; Americans (white) and English, 5 feet 7½ inches; American negroes, 5 feet 6½ inches; Germans, 5 feet 6½ inches; French, 5 feet 6¼ inches; Italians, 5 feet 6 inches; Chinese, 5 feet 4½ inches; Japanese, 5 feet 3½ inches.

A special division of anthropometry, which is extensively used in ethnology for classifying the races of man, is called *craniometry*. It deals with the detailed measurements of the human skull. Under this system all skulls are classified according to the proportion between their length and breadth, so that all people are divided into long-headed, medium-headed, and short-headed. Efforts have been made from time to time to read character by the shape of the skull (see Phrenology). This has not met with any recognized scientific success.

ANTIETAM (*ăn-tē'tam*), BATTLE OF. For weeks the tide of war in the East had been against the North, and the depression of the people, after McClellan's disastrous Peninsular campaign in Virginia in 1862, had been so great that Lincoln had been forced to postpone issuing his Emancipation Proclamation for fear of seeming to appeal to the negro for aid in a losing cause. When he laid aside the proclamation, however, he vowed that he would give it to the world after the first Union victory.

But instead of victory things grew darker. General Lee crossed the Potomac, carrying the war into the North, and striking terror into the hearts of the people of Maryland and Pennsylvania. Finally, on Sept. 17, 1862, his troops met the numerically superior troops of General McClellan at the little creek of Antietam in Maryland. All day long the battle raged with great slaughter, the loss on each side being about 11,000. No decisive results were obtained from the fierce conflict of that day, but on the next day Lee felt that it was wiser to withdraw from the field; thus the victory seemed to be left with McClellan. Lee had not obtained the aid from the people of Maryland which he had expected, and so he recrossed the Potomac into Virginia. McClellan made no attempt for a while to follow him, and so little military advantage was gained; but the people

of the North were encouraged and Lincoln had the opportunity to issue his Emancipation Proclamation. For these two reasons the battle of Antietam is one of the important battles of the Civil War.

AN'TIMONY. In its pure state antimony is of little use, but combined with other substances it is one of the most serviceable of metals. When you read a newspaper you may thank the antimony in the type-metal for the clear sharp print, for antimony has the unusual quality of expanding when it passes from the melted to the solid state, and this helps to give a sharp cast to the type letters by forcing the alloy into every corner of the mold. This metal also hardens the lead and tin with which it is mixed, so that thousands of copies of the paper can be printed without the type becoming blurred.

Antimony plays an important part also in the manufacture of munitions of war. It is specially used to harden shrapnel bullets so they will keep their round shape when the shell explodes. Many anti-friction alloys contain antimony.

In its pure state antimony is a brittle, brilliant blue-white metal, extracted chiefly from black ore called *stibnite*, which is the sulphide of antimony (Sb_2S_3). In ancient times stibnite was used by oriental women for painting their eyebrows and eyelashes. Antimony red, an oxysulphide of antimony, is still employed in the manufacture of certain brilliant red oil-colors and pigments, as well as for safety matches and fireworks. Stibnite is mined mostly in central Europe, China, and Japan, but recently large deposits have been developed in California, Nevada, and Alaska.

The salts of antimony are highly poisonous, having an effect similar to that of arsenic salts.

AN'TIOCH, SYRIA. The modern Turkish town of Antakiyeh, on the Orontes River, situated 20 miles from the Mediterranean Sea, at the angle formed by the great peninsula of Asia Minor, does not even remotely suggest the splendors of ancient Antioch, the "Queen of the East."

The old city was founded about 300 B.C. by one of the generals of Alexander the Great, and became the capital of the Seleucid kings of Syria. It drew great wealth from the caravan trade to India and grew into a center of Greek culture. Just beyond its 70-foot walls lay the famous and beautiful grove of Daphne, filled with magnificent temples which attracted pagan pilgrims from all parts of the civilized world of those days. The abandoned luxury of Antioch, even after it had passed under Roman rule, attracted the reforming spirit of the Apostles, especially Barnabas and Paul—and perhaps Peter—who are said to have sowed the seed which eventually converted half of the 200,000 population. It was here that the name "Christian" was first used (Acts ix, 26). The most famous saint of the region was Simeon Stylites, who spent 30 years doing penance on top of a high pillar, not far from Antioch.

After suffering severely from earthquakes, Antioch was sacked in 538 A.D. by the Persian king Chosroes, and never recovered its former glory. It was taken from the Seljuk Turks by the Crusaders after a nine-months' siege in 1098. For nearly two centuries it remained a Christian principality, then fell again to the Mohammedans in 1268, after great destruction and slaughter. This last blow ended ancient Antioch. Little remains of the old city except a few ruins of the great aqueducts and parts of the walls.

The Antakiyeh of today is a trade center for tobacco, corn, cotton, and silk, grown in the surrounding regions, and exports valuable quantities of licorice. The coming of railway transportation may revive its wealth, but the city is shabby and poor in appearance, and still suffers from its ancient foe—earthquakes. Population, about 25,000.

ANTISEPTICS. Not many years ago the slightest surgical operation was attended by the greatest danger. Even when the operation itself was entirely successful, the patient often died later from what was called "blood-poisoning." Now in 1863 Louis Pasteur, the great French scientist, published a report showing that decay in animal and vegetable substances was caused by microbes or germs.

This article attracted no notice among physicians until, in 1865, a copy fell into the hands of Joseph Lister, an English surgeon then working in Edinburgh. For years Lister had been trying to find the cause of blood-poisoning among hospital patients who had undergone operations. He was keen enough to see in Pasteur's discovery the answer to his problem. Blood-poisoning, he reasoned, was caused by these germs entering the wounds. So he began treating wounds with carbolic acid and other chemicals that destroyed these germs, and in this way he laid the foundation for modern surgery (see Bacteria; Germ Theory of Disease).

These germ-killing chemicals are called *antiseptics*, from the Greek *anti*, meaning "against," and *sepsis*, meaning "decay." Later Lister developed his antiseptic methods into *aseptic surgery* (from *asepsis*, meaning "without decay"). The difference is that in the former the germ was killed after it entered the wound, while the latter method, which is in use today, prevents the germ from getting in. This is done by using antiseptics to destroy the germs on all the surgical instruments, sponges, dressings, and everything which comes in contact with the patient during the operation. This process is called *sterilization*, and anything which has been made absolutely free from germs is called sterile or sterilized. For these great services to humanity Lister was made a baron.

Life-Savers in the World War

Naturally, antiseptic methods are not confined to surgical operations. Wounds received by accident or in battle are treated in the same way. During the World War of 1914-18 many improved ways of treating gunshot wounds were developed, which not only saved thousands of lives, but reduced tremendously the loss of limbs as the result of infection.

The antiseptics commonly used for medical purposes are carbolic acid, bichloride of mercury, iodine, iodoform, salicylic acid, peroxide of hydrogen, boric acid, and various coal-tar preparations. Most antiseptics are poisonous to men as well as to germs and they should always be used with care. But chemicals are not the only foes of bacteria; germs can also be killed by heat. Drinking water and milk are frequently boiled for this purpose, instruments are sterilized by heating in a flame or by boiling, and the clothing of patients who have suffered from contagious diseases is often burned to prevent the spread of infection.

To rid rooms and houses of contagious germs, or to kill insect pests, poisonous gases, such as formaldehyde, sulphur dioxide, and the fumes of hydrocyanic acid, are released after all doors and windows have been closed. This process is called *fumigation* and will usually exterminate within a few hours every living thing on the premises. In fact so many inexperienced persons have been killed while using the hydrocyanic acid method that it is forbidden in many cities. The common household antiseptics used to keep sinks and other plumbing in a sanitary condition are ordinarily called *disinfectants* or *germicides*, though most of them do nothing more than to destroy odors and hence should be called deodorants.

Preservatives for Foods

A distinction must be made here between two kinds of antiseptic agents. Those we have described are active germ-killers, but there are other methods which do not attempt to destroy the bacteria, but simply to prevent their development and activity. The latter are employed chiefly in the food industry, and the cold storage system is the best example. Chemical *preservatives* cannot be used on fresh meats, so the meats are frozen. This does not kill the germs of decay, but stops their work, which will be resumed as soon as they "warm up."

In curing hams and corned beef, however, and in canning and preserving other meats, as well as fruits and vegetables, the active antiseptic principle is used. These foods are smoked or salted or cooked, and sealed in air-tight receptacles—all of which prevents them from "spoiling" by first killing the old bacteria and then excluding all newcomers. The use of small amounts of chemical preservatives in foods, like ketchup, which have to be exposed to the air for long periods before they are consumed, is allowed by law, although the practice is carefully regulated by the government (*see* Pure Food Laws). Such preservatives are alcohol, benzoate of soda, sulphite of soda, and borax.

Wood which is exposed to the air is often given antiseptic treatment with creosote or tar, which keeps away the bacteria of rot.

ANTITOXINS AND SERUM THERAPY. The germs which cause the dreaded disease called tetanus or "lockjaw" produce in the body of their victim what is probably the most poisonous substance known.

This tetanus toxin or poison is about 250 times more deadly than strychnine. A drop or two injected into the blood of an elephant would kill it.

Yet medical science has discovered a treatment for fighting this poison—an "anti-poison" or antitoxin, as it is called—so that if a guinea-pig is given this treatment, he will survive the dose that kills the elephant.

People used to believe that disease germs produced their evil effects by feeding upon the blood or the tissues of the sick person. But scientists soon learned that the real cause of the trouble was a poison produced by the germs. This was proved by raising a colony of disease germs in a liquid culture, then filtering out the germs and injecting the liquid in which they had lived into some animal, which promptly developed the disease, although no germs had gone into its system.

Then the great discovery was made that nature had provided men and animals with a marvelous medicine right in their own bodies. As soon as the germs started making their poisons, the body of the victims started making anti-poisons. Then there was a race between the germs and the body. If the germs made poisons faster than the body made anti-poisons, the patient died; if the body could work faster, the patient got well. And not only did he get well but, in the case of many diseases, he became *immune* to the disease in question. In other words, if he had recovered from diphtheria, he could laugh at any new diphtheria germs for a while; they had no effect on him.

The Fighting Antitoxins

What had happened? He had developed in his system so great a quantity of the anti-poisons or antitoxins that these remained for a time in his blood ready to fight off diphtheria, if it should try to return. Perhaps his blood had even developed the power to destroy the germ itself before it could make any poisons.

It was found that these protective powers were contained in the *serum* of the blood—that watery substance which remains when the blood becomes clotted. Blood serum, therefore, which had acquired the power to fight germ poisons was called *antitoxic serum*; and that which had the power to destroy the germ itself was called *antibacterial serum*.

The discovery of these wonderful facts about blood serum gave rise to new methods of treating disease. Why not, asked the scientists, give artificial help to the blood in its fight against the germ poisons? This could be done in one of two ways: (1) by inducing the body to make its own antitoxin or antibacterial serum before the beginning of the disease; (2) by injecting into the body antitoxin or antibacterial serum produced by some other creature.

The first of these methods, known as the *vaccine* treatment, had actually been used in the case of smallpox long before the discovery of the germ theory of disease (*see* Germ Theory of Disease; Vaccination). But it was rapidly put into effect on other germ diseases such as typhoid fever, etc. In general, it con-

sists in inoculating a healthy person with dead or very much weakened germs of the disease in question, whereupon the blood of the person develops and maintains for some time the power to resist these same germs in their active or virulent state.

The second method consists in obtaining the toxin of the disease germs from an artificial culture, and injecting this toxin in gradually increasing doses into the body of some animal, usually a horse. Under this treatment the blood of the horse soon develops very high antitoxic powers. It is then drawn off in small quantities; the serum is separated, and is then ready to be injected into anyone threatened with the disease in question.

Cholera, bubonic plague, hydrophobia, influenza, cerebro-spinal meningitis, blood-poisoning, and pneumonia are among the maladies in which serum or vaccine therapy have been used with varying degrees of success. But the most striking results have been obtained in diphtheria, tetanus, and typhoid fever, especially as a means of protecting individuals against these diseases.

Formerly children suffering from diphtheria who were not given the serum treatment died in from 35 to 40 per cent of the cases; those who now get the treatment in time die in only 9 to 13 per cent of the cases. Tetanus was fatal in nearly every case before the discovery of antitoxin; now a number of the cases recover when promptly treated. But the great usefulness for tetanus antitoxin is in the prevention of the disease. Thus antitetanus serum was used wherever possible in treating the severely wounded in the World War of 1914-18, and thousands of lives were saved as a result.

Each year sees some new discovery, some improved method in this field of medicine, and it is not too much to hope that before long many other diseases will be cured or curtailed in this way.

ANT-LION. This singular creature, sometimes called the "doodle-bug," is remarkable for the ingenious way

ANT-LION DIGGING ITS PIT



This is an ant-lion just beginning to dig its pit. It works by pushing backward in circles and thus crowding aside the sand, which it throws out with its broad flat head.

the ant-lion—a short humpbacked creature, with a large head and strong curved jaws, which work sidewise. With its body buried in the sand and only

in which it hunts its prey. It is the young or *larva* of an insect somewhat resembling a dragon fly, but smaller, with four large lacy wings and a long slender body. The adult fly lays its eggs on the sand, and when the larva hatches it digs into the sand, using its head as a shovel, and forms a deep funnel-shaped pit, with steep sides. At the bottom lies

its cruel curved jaws projecting, it lies motionless until some unwary ant or other small insect falls over the edge of the pit and slides down. If the victim seems likely to escape, the ant-lion casts up a shower of sand with its strong broad head, and thus hastens the descent of the struggler.

The next time you see the pit of one of these creatures in the sand by the roadside, put your mouth down close to it and say: "Doodle-bug, doodle-bug, come out of your hole!" At once you will see a scrambling at the bottom of the pit, for your breath has set the sand grains sliding and the ant-lion thinks a victim is in his trap.

ANTWERP (*ănt'werp*), BELGIUM. The city of Antwerp, the metropolis of Belgium and one of the greatest seaports of Europe, has long played an important role in history because of its situation and its commercial importance. Located 50 miles from the open sea, on the right bank of the Scheldt River, which is here 2,200 feet wide, Antwerp possesses one of the finest harbors of the world, through which passes a huge volume of imports and exports, sometimes totaling a billion dollars a year. Besides its commerce Antwerp is important for its diamond-cutting, sugar-refining, brewing and distilling, and its manufacture of textiles and cigars.

Its commanding position was attained only after a long and troubled career. The city was founded some time in the 8th century and is said by some scholars to have acquired its name—*Hand-werpen* ("hand-throwing")—from the gruesome practice of one of its robber chieftains who cut off the hands of his prisoners and threw them into the Scheldt. By the middle of the 16th century Antwerp had become one of the most prosperous cities in Europe and the world's chief money-market, but in 1576 it was pillaged and burned for three days during the "Spanish Fury" because it had taken part in the revolt from Spain, which then ruled the Netherlands. The city was ruined and its inhabitants scattered.

Not until the days of Napoleon did it start again on the upward road, when it fell into the hands of France. Napoleon began the improvement of its harbor to make Antwerp a rival to London and a "revolver held at the breast of England." With this impetus Antwerp continued to grow even after the downfall of Napoleon's empire in 1814. Its commerce received another setback in 1830 when Belgium separated from Holland, for the latter country controlled both banks of the lower Scheldt and imposed heavy tolls on all vessels ascending or descending the river. This obstacle was not removed until 1863 (see Scheldt River).

Antwerp suffered another heavy blow at the opening of the World War in 1914. Although its fortifications had been strengthened after the Franco-Prussian War of 1870-71, so that it was considered the strongest fortified city in Europe, it took the Germans only ten days to drive out the Belgian army. On Oct. 8, 1914, they occupied the town, which they had long coveted

because of its strategic location, and did not give it up until their withdrawal from Belgium in 1918.

In spite of all these disasters there still stand in Antwerp some of the old buildings. The most famous is the cathedral of Notre Dame, which was started in the 14th century. With its 400-foot tower it is the most conspicuous building in the city, and in it are housed three of Rubens' great paintings, 'The Descent from the Cross,' 'The Elevation of the Cross,' and 'The Assumption.' Other important

later near that same spot he found a thigh bone that had evidently belonged to this same prehistoric skeleton. Upon studying these remains he decided that what he had found was a specimen of the long sought "missing link," the supposed ancestor alike of man and the higher apes. He named his discovery *Pithecanthropus erectus* ("erect man-ape"), and soon the whole world rang with his discovery and discussions as to its meaning. Scientists now generally believe that the creature was not the earliest of the apes, as

THE MONKEYS AND THE "MISSING LINK"



This is one scientist's reconstruction of *Pithecanthropus erectus*, made from the few bones found in Java. Was the creature man or ape? Probably he was a "running ape" who differed from his tree-dwelling relatives chiefly in the greater size and development of his brain. Of course this is only a guess at his appearance.

As you pursue the fascinating study of science and get into the subject of evolution, you will hear a great deal about "missing links," and particularly about the link that is supposed to connect man with the monkey family. This group of pictures will enable you to form some notion for yourself as to the close relation between the lowest order of men and the highest representatives of the monkey tribe, the apes. On the left are two apes (chimpanzees) in the New York Zoo, familiarly known by their friends as Susie and Dick, while on the right is a restoration of the head of the "missing link" which a Dutch doctor found in the island of Java. Scientists call this strange creature *Pithecanthropus erectus*, which is Latin for "erect man-ape."

buildings are the richly decorated town-hall, built in the 16th century, and the gallery containing a priceless collection of Rubens' and Van Dyck's paintings. Fine boulevards mark the site of the old city walls. Population, about 310,000.

APE. Man's nearest cousins are the tailless semi-erect apes—the chimpanzee, orang-utan, gorilla, and gibbon—which inhabit tropical Asia and Africa; the likeness is especially strong in the young.

In 1891 a Dutch doctor in the island of Java, while watching some workmen digging in a river bank, saw them unearth some very old fossil bones—some teeth and part of a skull; and a year

was at first thought, but rather the earliest of men of whom we have found any material traces—though the apelike characteristics are very strongly marked.

In the structure of their bodies apes approach man

very nearly, and the bodily differences are no greater than those which separate the various species from one another. Indeed it requires special anatomical knowledge to appreciate what these differences are. Even in the brain structure the differences between the apes and

THE WONDERFUL HAND THAT MAN SHARES WITH THE APES



One of the most important steps in the upward progress from the lower animals to man was the development of a hand with an "opposable" thumb, that can be easily made to meet the tips of the fingers, so that it can grasp and wield tools. The members of the ape and monkey group are the only animals that share with man the possession of this enormous advantage. In this picture, which shows in order the hands of the orang-utan, gibbon, gorilla, macaque, baboon and chimpanzee, you can easily see the resemblance to the human hand at the right.

the lowest of mankind are chiefly in size, in convolutions, and in microscopic structure. The convolution containing the brain cells that preside over

speech (called the convolution of Broca) is lacking in the apes, and there are of course other differences.

Apes live chiefly on fruits and other vegetable food. The gorilla is as large as or larger than man. All apes can walk erect as man does, though they are more at home in climbing, as is shown by the handlike character of their feet. They have no tails and no cheek pouches, and have great strength and intelligence. The gorilla, especially the male, is by nature very savage and among the most dangerous of wild animals. The orang-utan is less savage. The chimpanzee and especially the gibbon are timid and easily alarmed. (See also Chimpanzee; Gorilla; Orang-utan.)

The doctrine of evolution does not teach that any existing ape is in the direct line of man's ancestry, but that the "simian" (or monkey) line and the human line are united in remote ancestors common to both groups.

The existing apes are, therefore, side branches as it were of the ancestral tree, and not in the direct line of descent. The apes are progressing in their habits. Some of them build rude stone shelters, use clubs and stones in defense, and so forth; but a popular misconception should be corrected—their progress is not directly toward humanity, but toward a more perfect apelike character.

APENNINE MOUNTAINS. Picture to yourself a vast dreary mountain wall, with parts of its surface bare, and few projecting peaks to break the dull monotony of the scene. Such is the great Apennine range which forms the backbone of the Italian peninsula, covering about two-thirds of its area. It extends from Savona, near the head of the Gulf of Genoa, to Reggio in the toe of the boot. The general shape of the range is that of a bow, 800 miles long and varying from 25 to 85 miles wide.

Only in the Abruzzi in the center of the peninsula, and in the marble mountains of Carrara and Seravezza, do the bold and magnificent forms of the Alps appear. Here the mountains parallel the eastern coast so closely that in many places there is hardly room for more than a narrow road between the abrupt mountain sides and the Adriatic. The highest summit of the Apennines, Mt. Corno (9,585 feet), lies in this part of the range. Few of the peaks are more than 6,500 feet high. The famous Mt. Vesuvius (4,200 feet), an active volcano which in ancient days destroyed the Roman cities of Pompeii and Herculaneum, lies in a smaller chain to the west, sometimes called the Lower Apennines.

The widespreading uplands and slopes furnish excellent pasturage where there is water, and the lower flanks are in many places covered with groves of orange, citron, olive, and even palm trees. Along the western base are found many pleasant valleys, much wider than the valleys of the Alps, covered with a varied vegetation and sheltering famous cities and picturesque villages. The Apennines contain little mineral wealth and the lack of adequate supplies of coal and iron is a great drawback to Italy.

All the rivers of Italy south of the Po valley rise in the Apennines. Those on the Adriatic side, where the mountains approach nearest the coast, are mere mountain

torrents. On the western side there is room for larger streams to develop; of these the Arno and the Tiber are best known.

APHIDS (ăf'idz). On the stems and leaves of plants one often sees very tiny greenish or blackish creatures,

MILKING TIME IN ANTDOM



Any time is milking time among the ants; whenever you feel hungry and come across a "cow." Miss Ant, who is also her own dairy-maid, is here stroking the little aphid "cow," who is thus induced to "give down" the honey dew that the ants so greatly relish.

with soft rounded balloon-like bodies, usually clustered in dense groups. These are *aphids*, or plant-lice as they are more commonly called. They are found on nearly all kinds of cultivated plant life, the grape aphids or *phylloxera* being one of the most destructive species. Our most common forms are very small, never more than an eighth of an inch in length. They have long slender legs, and long antennae or feelers. The tiny head bears a pair of very large eyes and a long beak. With this they suck up the sap of plants. Usually they have no wings, but sometimes aphids hatch which have wings. With these they may fly to other plants, and so prevent overcrowding.

Most aphids form a sweet liquid known as "honey dew," which is greatly relished by some species of ants. To obtain this the ants stroke the aphids gently with their feelers and then drink the honey dew as it is poured out. Some ants even capture the aphids and carry them to plants near their nests, where they care for them in the most tender way, driving away enemies and seeing that they are placed on strong young plants. That is why the aphids are sometimes called "the ants' cows."

These curious little creatures sometimes multiply by laying eggs, but among most forms the females bring forth the young alive, generation after generation in rapid succession. Their numbers increase so rapidly that they would kill the greater part of plant life if it were not for their many enemies. One of the natural enemies of aphids is the ladybird beetle, which aids a great deal in keeping down their numbers.

Scientific name, *Aphididae*; order, *Hemiptera*. The grape aphid is *Phylloxera vastatrix*.

APHRODITE (*ăf-ro-dī'tē*). Far back in the dawn of creation, the goddess Aphrodite—so the poetical Greeks imagined—sprang full-grown from the sea, where its waters had been dyed a rosy red with the blood of one of the gods, wounded in a quarrel with his son. From the tossing foam arose the radiant Aphrodite, goddess of love and beauty, the fairest creature of heaven or earth. A huge sea-shell floated nearby, as it chanced. Lightly the lovely goddess sprang upon it, and as she stood there the glistening drops of water rolled from her shining limbs and beautiful tresses, and fell into the shell as splendid pearls.

Look, look, why shine
Those floating bubbles with such light divine?
They break, and from their mist a lily form
Rises from out the wave, in beauty warm.
The wave is by the blue-veined feet scarce press'd,
Her silky ringlets float about her
breast,
Veiling its fairy loveliness; while her
eye
Is soft and deep as the blue heaven is
high.
The Beautiful is born; and sea and
earth
May well revere the hour of that
mysterious birth.

—Shelley.

Entranced with her loveliness, Zephyrus, the gentle god of the west wind, breathed softly upon the shell and wafted it to the island of Cyprus. At the touch of her feet on the dry sand, grass sprang up and flowers burst into bloom, filling the air with their ravishing odors. Verdure clothed the whole island to greet the new-born queen of love, and a company of beautiful maidens appeared to receive her—the “rosy-bosomed Hours”, and the three lovely Graces, who rejoiced in the sweet-sounding names of Aglaia, Euphrosyne, and Thalia. They decked her with garments of immortal fabric, placing a crown of gold on her brow, a glittering chain on her neck, and precious rings in her ears.

The Woes Caused by the Goddess

They escorted the new-born goddess, thus arrayed, to the summit of Mount Olympus, where the other gods had their dwelling. At the sight of such surpassing beauty the gods were entranced and each desired her for his wife, but the proud Aphrodite rejected them all. So to punish her, Zeus the king of gods and men gave her to be the bride of Hephaestus (Vulcan), the lame and awkward but good-natured and wonderfully skilful god of the forge. All the gods and goddesses brought gifts for the bride. But the most wonderful of all were the presents wrought by Hephaestus himself. These included a palace in the island of Cyprus, built of white marble, with towers and ornaments of gold and silver. In it were golden

harps which made sweet music all day long, and golden birds which sang the sweetest songs. But Aphrodite was faithless and fickle, and caused much woe on Olympus and among men by reason of her preference for other gods and other men. The story of her love for the beautiful youth Adonis is told elsewhere in this book (*see Adonis*).

Unlike her sister-goddess Athena, Aphrodite seldom dared take part in the wars of gods and men. Indeed the poet Homer styled her “a coward goddess and none of those that have a mastery in the battle of warriors.” But since it was through her that the Trojan prince Paris had stolen away the beautiful Helen from Greece, Aphrodite did what she could to aid the Trojans in the war that followed.

How She was Wounded by a Mortal

When once a Trojan warrior particularly dear to her was wounded in battle with Diomedes, she wound about him her white arms and spread before him the protection of her radiant vesture, and sought to bear him from the field. But raging Diomedes cried out:

“Is it not enough that thou beguilest feeble woman? If in battle thou wilt mingle, verily I deem that thou wilt shudder even at its name when heard afar off.”

So saying he thrust with his keen spear and wounded the skin of her weak hand; and straight through the ambrosial garment that the Graces themselves had woven pierced the dart into the flesh. Then flowed the ichor, the sacred blood of the gods, from her veins, and Aphrodite fled in amaze and sore troubled to Olympus to be healed and consoled.

The name *Aphrodite* means “born of the sea-foam.” Aphrodite is often represented as accompanied by her son Eros (Cupid), a lovely, rosy, mischievous child with a bow and quiver of love-compelling

arrows. The worship of Aphrodite was widespread. Her connection with the sea endeared her to sailors, and on land many temples were built in her honor. On the waters the swan and dolphin were sacred to her; on land the dove and the sparrow. As goddess of flowers and fruitfulness she loved especially the rose, the poppy, and the myrtle. As goddess of love she ruled the hearts of men. Many poets have sung of her, and painters and sculptors have delighted to picture her as the perfect type of feminine beauty.

The Romans identified their goddess Venus with the Greek Aphrodite. One of the most beautiful statues that have come down to us from antiquity is the famous *Venus of Milo*, found buried amid ruins in the Greek island of Melos (Milo) in 1820, and now one of the prized possessions in the museum of the Louvre in Paris.

APOLLO. Of all the twelve great gods of Greece, the most widely worshiped and many-sided was Apollo. He was the god of light and of youth and manly beauty; and as the god of prophecy the priestess of the oracle at Delphi was his servant.

VENUS OF MILO



This is the head and bust of what is regarded as the most beautiful statue in the world, the Venus of Milo. When found the arms were broken off and missing. One theory is that the goddess held in her hand an apple, which was the symbol of the island of Melos (Milo), on which her statue was found.

One of the earliest deeds of the young Apollo was the slaying of the deadly serpent Python, born of slime and stagnant waters, which infested the slopes

THE APOLLO BELVEDERE



This picture shows the head and shoulders of the most famous of all the statues of Apollo—the Apollo Belvedere; "all-radiant from his triumph in the fight."

near Delphi. No man dared to approach the monster, and the terrified people cried out with uplifted hands:

"O Apollo! Save us from this plague of suffering and death!"

Then the young god, beautiful as the morning and the enemy of all things ugly or evil, came down from Olympus with his shining bow in his hand and a quiver upon his back. Twang! sang the bowstring and away sped a golden arrow. And soon the writhing hateful monster had

ceased to send forth his poisonous breath. In memory of this conquest Apollo instituted the Pythian games, held every four years in ancient Greece, in which the victor in feats of strength, swiftness of foot, or the

Once a vain and boastful satyr named Marsyas found a flute which the goddess Athena had thrown away because playing it distorted her features. When Marsyas discovered that of its own accord it gave forth the most delightful strains, he became so conceited that he challenged Apollo to a musical contest.

The nine Muses—goddesses of music and poetry—were chosen as judges. Marsyas was first called upon to play, and charmed all by his melodious strains. The Muses bestowed upon him much praise, and then bade Apollo surpass his rival if he could.

The god seized his lyre and brought forth the most wonderful melodies. A second time they strove, and on this occasion Apollo sang to the accompaniment of his lyre. He was hailed by all as the conqueror, and poor Marsyas forfeited not only the contest but his life as well, for according to the agreement the one who lost was to be flayed alive.

Apollo was the son of Zeus and twin brother of Artemis (Diana); he was born on the island of Delos in the Aegean Sea, his mother being the goddess Leto (Lato). Later, through confusion with Helios, he came to be considered especially as the sun-god. The Greeks connected him with agriculture, and called him "the protector of the grain," "the sender of fertilizing dew," "the preventer of blight," "destroyer of locusts," and "destroyer of mice." They considered him also the guardian of flocks and herds, and a health-giving god. He was hailed as the "far-darter" and "god of the

THE DANCE OF APOLLO AND THE MUSES



As the god of music, Apollo is frequently represented as the leader of the choir of the Muses, the inspiring goddesses of song. In this reproduction of a painting by Jules Romain, a pupil of Raphael, the names of the nine Muses are given in Greek. You can easily identify Apollo in the center with his quiver. The Muses, beginning at the left, are Urania (the muse of astronomy), Thalia (comedy), Euterpe (lyric poetry), Polyhymnia (religious music), Terpsichore (dancing), Melpomene (tragedy), Erato (love poetry), Clio (history), Calliope (epic poetry).

chariot race, was crowned with a wreath of laurel leaves.

Apollo was also the god of song and music, and charmed the gods with his playing at the banquets held in their palaces on Mount Olympus. It was said among the later Greeks that he invented both the flute and the lyre.

silver bow," and in wartime as "the helper" and "god of the war cry."

At Delphi in western Greece, near the foot of Mount Parnassus—which was sacred to Apollo and the Muses—was the famous oracle of Apollo. Here his priestess made known the future to all who consulted her, giving guidance in matters of sickness, war and peace,

and in the building of colonies. As the god of prophecy the tripod was sacred to Apollo.

Apollo was represented more frequently than any other deity in ancient art. Sculptors delighted in portraying him as a beautiful youth with flowing hair tied in a knot above his forehead, which was bound with a wreath of laurel, and bearing his lyre or bow. The most famous statue of him is the Apollo Belvedere in the Vatican palace, at Rome. This is an ancient masterpiece in marble, which represents him at the moment of his conquest over the Python. His left hand outstretched was supposed to hold the bow, from which his right had just released the arrow.

APOSTLES. "He went into the mountains to pray, and continued all night in prayer to God. And when it was day he called his disciples, and he chose from them twelve men whom he also named apostles."

In these few words the New Testament tells us of the choosing by Jesus of the 12 men whom he selected to be near him for continuous instruction and later to spread abroad his message. The word *apostle* (from Greek words meaning "from" and "to send") signifies a messenger and teacher. These 12 men were Simon (called Peter), Andrew his brother, James the elder (son of Zebedee), John his brother, Philip of Bethsaida, Bartholomew, Matthew, Thomas, James the younger (son of Alphaeus), Simon (called Zelotes), Judas (called Thaddeus, the brother of James the younger), and Judas Iscariot, who betrayed Jesus to the high priests and then, overcome with remorse, committed suicide. The number 12 was symbolical, signifying the 12 tribes of Israel. Matthias was chosen by the drawing or casting of lots to supply the place left vacant by Judas Iscariot. Simon Peter and Andrew, and John and James the elder, were fishermen, and Matthew was a "publican" or tax-gatherer.

Save for the very meager accounts in the New Testament, the literature of the early church is so fragmentary that there is no full or certain knowledge of the lives of the Apostles. It is natural, therefore, that a great mass of tradition, much of it unreliable, has sprung up around the names of these beloved leaders, who by their teaching and even martyrdom established the Christian church.

The Apostolic Tradition

Peter, apparently, was the leader of the Apostles and was present at most of the incidents in the life of Jesus recorded in the New Testament. He, with the sons of Zebedee (James and John), formed a little inner circle within the Twelve, and this favored group was present at the raising of the daughter of Jairus, the transfiguration on the mount, and the scene in the Garden of Gethsemane. Although Andrew, brother of Peter, is only mentioned a few times, he too seems to have been later included in this little inner circle; for when the Greeks asked Philip if they might see Him, he consulted Andrew before laying the matter before the Master. A widespread tradition concerning Peter holds that he went to Rome and suffered martyrdom there (*see* Peter, Saint).

Andrew, it is said, suffered martyrdom in Greece. What is supposed to be part of his cross is inclosed in one of the four great piers of the dome of St. Peter's

Church. This cross is traditionally reported to have been shaped like a letter "X" whence comes our "St. Andrew's cross."

John, "the beloved disciple," is represented throughout the Gospels as fiery natured. After the crucifixion John appears to have been with Peter and the other Apostles at Jerusalem and is, after Peter, the most prominent of those who bear witness to His resurrection. It is not now believed by scholars that he wrote either the Gospel, the Epistles, or the Revelation named in his honor.

His brother, James the elder or the greater, must have been very prominent in the early church. He was the first martyr, being slain by King Herod in Jerusalem (Acts xii, 1, 2). Some authorities believe that John also was slain at that time, although tradition has given him a long life of missionary service.

Thomas, sometimes called "doubting Thomas" because he would not believe in the resurrection until he could see and touch the Master, is yet a character of singular charm and interest. When Jesus, despite imminent danger at the hands of the Jews, declared his intention to go to Bethany to heal Lazarus, Thomas alone supported the Master against the other disciples, who sought to dissuade him, and said, "Let us also go, that we may die with him" (John xi, 1-16). Tradition says that Thomas went to India after the crucifixion. The name "Christians of St. Thomas" is often applied to the members of the ancient Christian churches of southern India, who claim him as their first evangelist and martyr.

Others who Suffered Martyrdom

Of Philip, Bartholomew, Matthew (the reputed author of the First Gospel), Simon Zelotes, Thaddeus, and James the younger, we learn little from the New Testament. Bartholomew, one legend says, was flayed and crucified while on a missionary trip to India, a very wide designation in those days. In works of art he is generally represented with a large knife, the instrument of his martyrdom, and in Michelangelo's 'Last Judgment' he appears with his skin hanging over his arm. Early authorities state that Matthew died a natural death, but by other writers he is said to have suffered martyrdom after preaching in Ethiopia. James the younger, it is said, was stoned to death for persisting in his evangelistic work in Israel.

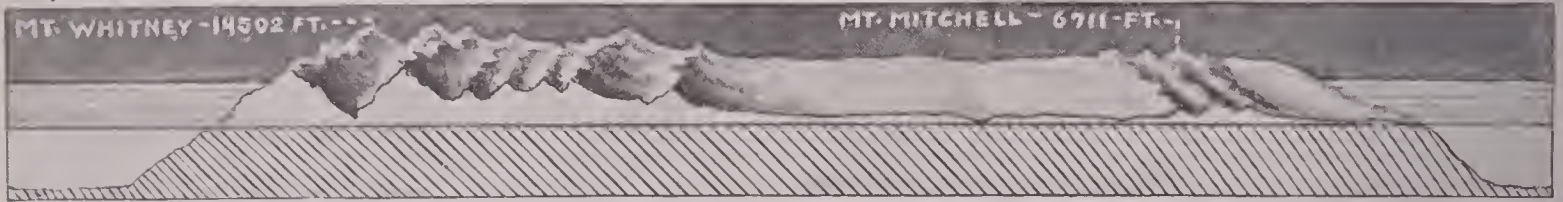
The name "apostle" was later applied to Paul, and to Barnabas who accompanied Paul on his travels (*see* Paul, Saint). It is also given at times to such apostolic assistants as Luke "the beloved physician," the traditional writer of the Third Gospel and the Book of Acts. It will be noted that only two of the four Gospels bear the names of real Apostles. Mark, to whom the Second Gospel is ascribed, is believed to have been the unnamed youth who fled from the Garden when Jesus was made prisoner. Later he was Peter's constant companion in his missionary travels. The Gospel which bears his name, and which critics

generally agree that he wrote, was the first of the Gospels to be written and was based on his recollection of Peter's teachings.

APPALACHIAN (*ăp-a-lăch'i-an*) **MOUNTAINS.** For a century the continuousness and bewildering number of the forest-clad ridges of the Appalachians kept

yellow pine farther south. On the poorer lands evergreens flourish, and their dark foliage covering the summits of the Black Mountains gives this range its name. Bears, mountain lions (puma), and wild cats (lynx) haunt the more remote fastnesses. Foxes are numerous, deer are found in some districts, and

THE AGED APPALACHIANS AND THE YOUNG ROCKIES



To speak of anything several million years old as "young" seems odd to anyone but a geologist. But in the history of mountains a million years is merely the tick of a watch. Here is a cross-section of North America, which brings into sharp contrast the difference between the old worn-down Appalachians and the comparatively young and still sharply outlined Rockies. Compare Mt. Whitney, nearly three miles high, among the young giants of the West, and Mt. Mitchell less than half as high, which is the highest of the Appalachians. Centuries of battle with the winds and storms and frosts and running water finally wear down the loftiest of mountains.

the English colonists from extending their settlements westward. Only in the north, by way of the Hudson and Mohawk valleys, and at the southern termination of the system were there easy routes to the Mississippi Valley, and these were jealously guarded in the north by the French and in the south by the Spaniards.

But the broad valley between the Blue Ridge and Alleghenies of eastern Pennsylvania was easily accessible; and here German religious refugees (the "Pennsylvania Dutch") formed settlements, and with Scotch-Irish immigrants slowly drifted southward into the back country by means of the longitudinal valleys between the mountain ridges. With the removal of the French power, which followed the French and Indian War (1755-63), the farther barriers of the Alleghenies were crossed, and English settlements at least reached the Ohio and Mississippi valleys. Today, at a dozen or more points by means of tunnels, cuts, and zig-zag climbs, the railways surmount these barriers, so that the sleeping traveler in his Pullman scarcely realizes that the obstacles ever existed.

Although this mountain system has neither the height nor the grandeur of the Rocky Mountains, it is much older geologically. It extends from Newfoundland and New Brunswick southwestward for 1,500 miles to central Alabama. A remarkable feature of the chain is the regular arrangement of its low ridges, which throughout its length run almost parallel to the Atlantic coast. The mountain sides and summits are covered with forests. The ridges have round-topped summits rising to rather uniform heights.

In the spring, when the laurel, rhododendron, and azalea are in bloom, the slopes and valleys of the southern Appalachians are a maze of riotous color. These and other flowering and fruit-bearing shrubs grow in such profusion as to form almost impenetrable thickets. White pine is found in the north; the maple, white birch, ash, and beech also grow on the northern mountains; and the oak, cherry, white poplar, and

moose in the extreme north. Wild turkeys and smaller game birds are plentiful on the southern ranges.

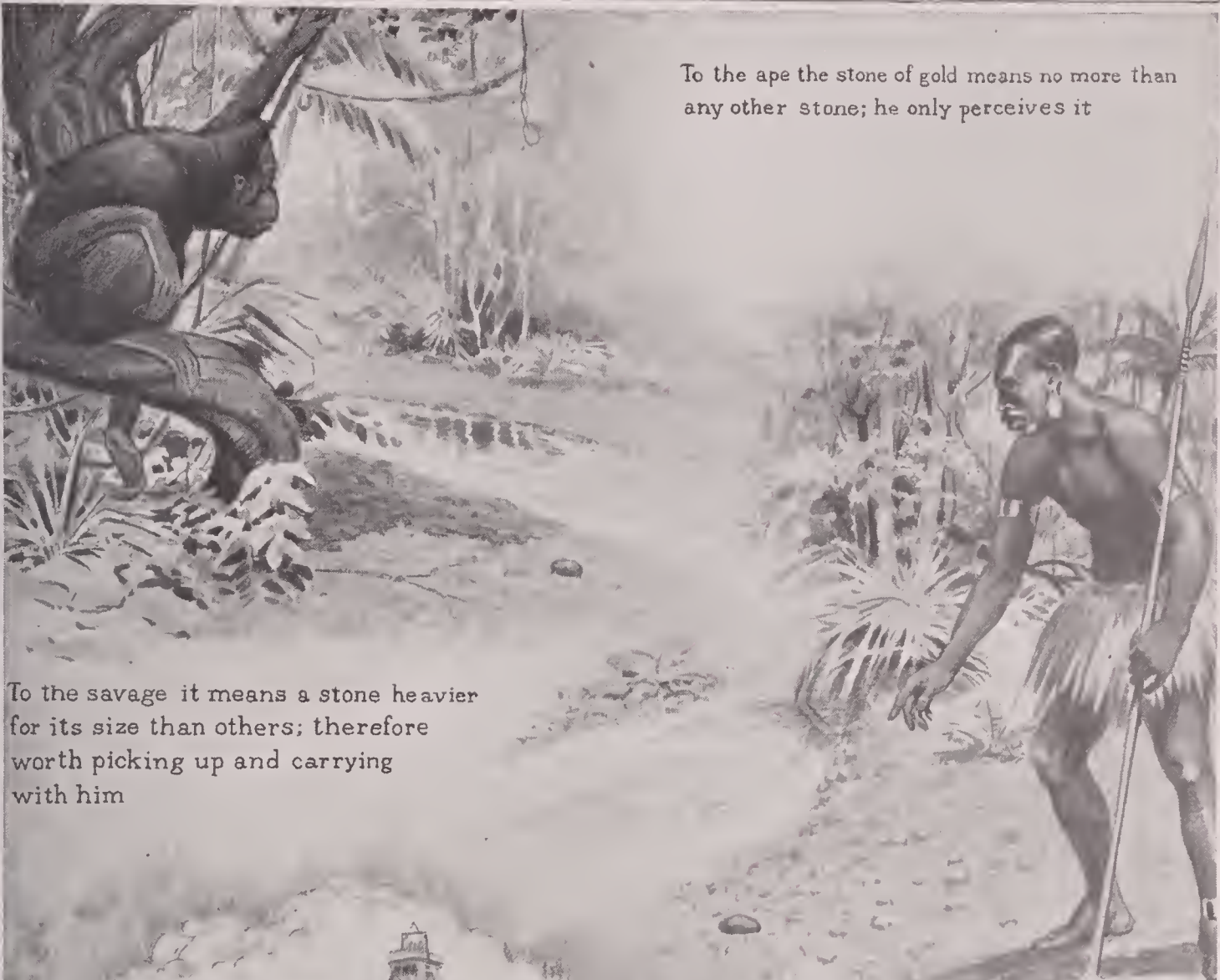
When the Appalachians were in process of formation, enormous swamps of the old plain, filled with the remains of marsh vegetation, were covered with earth and finally folded up in mountain-making; these buried beds of vegetation now form the coal beds of Pennsylvania, West Virginia, and other states. Large deposits of iron ore, marble, limestone, and gypsum are also found in the Appalachians.

One of the many interesting features of these mountains is their deep crosswise "gaps," carved by the eastward-flowing rivers—the Potomac, the Delaware, the Susquehanna, and others—on their way to the Atlantic Ocean.

Among the chief ranges in the north are the White and Green Mountains of the New England states. The Adirondacks and the Catskills of New York are not properly considered a part of the Appalachian system. Farther south the Allegheny and the Blue Ridge stretch from southern Pennsylvania, through Virginia and West Virginia—where they inclose the beautiful Shenandoah Valley—and into Tennessee and North Carolina. In these states and extending into Alabama are the Smoky Mountains and the Black Mountains. The highest peaks are found in the Black Mountains of North Carolina, the loftiest of which, Mount Mitchell, reaches an altitude of 6,711 feet. In the north Mount Washington, in the White Mountains of New Hampshire, is the topmost peak, rising to a height of 6,293 feet.

APPERCEPTION. Suppose a person in crossing a stream sees what looks like a dull yellow stone. It does not differ much from the other stones surrounding it, and if the observer does not know enough about that sort of an object to make it more interesting to him than its neighbors, it will not arrest his attention. He has only perceived it. Suppose, however, that the observer is a savage who has noticed such stones before, and that they are unusually heavy and therefore valuable as missiles. Such a person would get from seeing the stone a number of suggestions connected with warfare or the hunting of wild animals, and be sufficiently interested to pick it up and carry it away. This observer has gone a

A PICTURE-DEFINITION OF APPERCEPTION



To the ape the stone of gold means no more than any other stone; he only perceives it

To the savage it means a stone heavier for its size than others; therefore worth picking up and carrying with him



But to the mining engineer it means gold! and gold in turn calls to his mind a world of associations, in short he apperceives it

step farther and related what he sees to what he has seen and knows. He has apperceived.

But if a civilized man perceives that the object is not an ordinary stone, but a nugget of gold, his interest will become intense because of his knowledge of its use as money and in the arts. He will not only pick up the nugget but will do so eagerly. A great number of ideas will surge into his mind, and it may be some time before he will think of anything except his discovery and its significance. Moreover, his actions will be very extensively modified by the experience. If he happens to be a miner, he may perceive in the nugget the suggestion of a rich deposit of gold in the neighborhood, and the current of his life may be turned by its discovery. This is a fine example of *apperception* where according to the German philosopher Herbart (1776-1841) old experiences assimilate and give memory to new experiences or perceptions. The assimilating power of the mind is called apperception.

The active force in apperception is, with Herbart, experience itself, and not, as with Kant, a mind that is thought to organize experiences which are themselves passive.

The consequences to education of this view of Herbart are very important, especially to the teacher or parent. For the successful apperception of a new object depends upon two things: First, whether the learner already possesses any experience with which to interpret it; and second, whether the new perception comes in such a way that it calls up this interpreting experience. Both of these conditions the teacher can understand and at least partially control. He can, before he presents a new topic, investigate what the child already knows about it. This will tell him whether the child can apperceive the topic at all and, if so, to what extent and in what way.

Such a preparation brings all or the most valuable part of the related experience possessed by the child actively to bear on the new idea, thus insuring its apperception. Later, as the new subject becomes better mastered, the teacher can suggest the connections between it and other related subjects—thus increasing the degree of organization of material in the pupil's mind. Finally, the ideas thus mastered can be continually revived at the suggestion of the teacher in order to interpret new material or solve new problems.

From this point of view the teacher is seen to have the task of not merely connecting the new object with familiar experience, but also that of helping the child to see how, in the light of his experience, the comprehension of the new topic is worth while. In this aspect apperception is very intimately related to the educational theory of *Interest*.

APPLE. The apple is the king of fruits, and it has been cultivated since the earliest times of which we have any knowledge. Charred remains of apples have been found in ruins of prehistoric lake-dwellings, and rude pictures of this fruit were carved long ago by the Stone Age men. References to it are common in the literature of almost all countries and all ages, and fairy-tale and folklore abound with stories of apple trees and golden apples. The apple is mentioned in the Bible many times; the Greeks held the Apple of Discord, awarded by Paris to the goddess Aphrodite, responsible for the fall of Troy; and Pliny, a writer of ancient Rome, tells of 22 varieties of apples common in his day. The fruit was probably introduced into England by the Romans during the three centuries that they ruled that island.

It seems curious to find that the apple belongs to the great rose family, as do also the peach, cherry, plum, raspberry, and many other fruits. But when we remember the red seed pods of the rose, sometimes called "rose apples," the relationship does not appear

so strange. We can also see a resemblance between the exquisite pink and white blossoms of the apple tree and the wild roses which bloom in such profusion along our country roads. It was probably as a hybrid of two species of small wild crab-apples that the apple as we know it in history first appeared in Asia Minor.

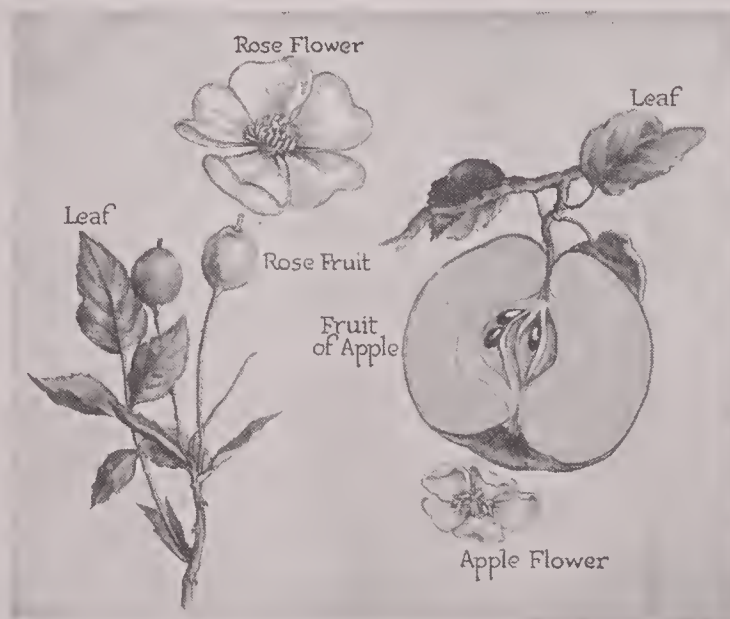
No fruit can be cultivated over so wide an area of the globe, and none is grown so far north. In Europe there are apple orchards in Scandinavia, and as far south as the mountain regions of Spain. The apple tree thrives best,

however, in the middle temperate climates.

Greatest of Apple Countries

The United States is the greatest apple country in the world. The fruit is extensively cultivated from New Brunswick to the mountains of Georgia and from British Columbia to the mountains of Mexico. The actual number of varieties produced in North America is not far from 1,000, although only about 100 varieties are commercially profitable, and usually not

THE APPLE AND COUSIN ROSE



Notice what a striking family likeness there is not only between the leaves and blossoms of the apple and the rose, but between the fruits (really the seed pods in both cases). Many other orchard fruits belong to this same great rose family.

more than 20 can be cultivated successfully in any one region. Generally speaking, the later or "winter apples" thrive best farther north, and the earlier varieties are better suited to the warmer regions.

Apple trees were brought to this country about 1629 by one of the governors of the Massachusetts Bay Colony, although there are native species of wild crab in America. As the colonists worked their way westward they planted apple orchards, and Johnny Appleseed earned name and fame by planting apple seeds everywhere he found a fertile and well-watered spot in Indiana and Ohio. Apple culture is adapted to all parts of the country, with the exception of Florida and the lands immediately bordering the Gulf of Mexico and the warmer localities of the southwest and southern Pacific region.

New York Ranks First

The United States produces annually about 200,000,000 bushels of this fruit. New York ranks first among the states in the production of apples, with Michigan second, Pennsylvania third, and Missouri fourth. The piedmont region of Virginia has long been famous for the delicious apples grown there. In the past few years the western states, particularly Washington, Oregon, Idaho, and Montana, have undertaken the cultivation of apples on a large scale

At harvest time the fruit of these great orchards is hand picked, graded, wrapped, and carefully packed in boxes, and brings high prices in the markets of the world as table fruit.

Apple trees require careful cultivation and the best fruit is produced only when every attention is given in the way of grafting, pruning, spraying, fertilizing, and the like. There are many troublesome diseases to which these trees are subject, the most destructive being apple scab and rust,

both fungous growths. The trees are also attacked by numerous insects, among them being the codlin moth, which lays its eggs on the flowers, and the apple-tree borer, which attacks the trunk and destroys the life of the tree.

Apples are among the most delicious as well as the most wholesome of fruits. They can be stored and kept many months, indeed until the early summer varieties of the next year are on the market. They are also dried, evaporated, and canned. Cider is made by pressing out the juice of the apple, and from this juice the best vinegar is made.

The following are some of the best-known varieties: Baldwin, Banana, Delicious, Early Harvest, Grimes Golden, Jonathan, Maiden Blush, Spitzenburg, Northern Spy, Rambo, Rhode Island Greening, Rome Beauty, Spice Russet, Wine-sap, Yellow Bellflower, Ben Davis, Duchess, Yellow Transparent. All

the common species are developed from the *Pyrus malus*; order *Rosaceae*.

APRICOT (*ā'pri-cōt*). When the first warm breath of spring moderates the winter's chill the fruit buds of the apricot trees begin to stir. The dainty shell-pink

JUST LOADS OF THEM



This picture tells better than words can do how prolific the apricot is. The branches of this tree were so loaded—as they usually are—that it was necessary to prop them to keep them from breaking down.

APRICOTS DRYING IN THE SUN



Here we are looking into one of the orchards in California from which we get the dried apricots we buy at the grocery store. After the apricots are picked, they are cut in half and pitted, the two halves turned face up and left to dry on sloping trays. Large quantities of the pits are shipped to Europe, where an oil much like almond oil is pressed out from them.

on irrigated soil, and are raising not only some of the choicest varieties of apples grown, but are producing a greater number of barrels every year. The apples of the west are rich in color, juicy, and of fine flavor.

blossoms beautify the bare twigs of the mother tree long before most other fruits have heard the gentle call to waken. Although closely related to the peach and plum, the apricot does not survive in the colder

regions as do its cousins; this no doubt is mainly because of its early-blooming habit.

Tiny leaves appear soon after the flowers, and when the petals have fallen away the tree is covered with luxuriant light green foliage. The small green fruits grow very slowly until the stone is formed, but after the pit has developed they fill out rapidly and ripen in the latter part of July and in August. Indeed, the name apricot comes from Arabic and late Greek words meaning "early ripening."

The fruit resembles both the peach and the plum. The tree is plumlike in leaf and habit, and peachlike in bark. Each tree bears a large quantity of fruit, which when fresh has a mild neutral taste, and makes excellent marmalade and preserves. When canned or dried its flavor is more pronounced, making the apricot a general favorite.

The apricot, of which there are three species, is a native of China. It was introduced into Europe in the days of Alexander the Great and has been grown successfully in California since the early mission days. It is now one of the most important of commercial fruits in that state. Scientific name, *Prunus armeniaca*.

APRIL. The Latin word for April comes from one meaning "to open," and true to its name, the month opens the gates that summer may enter. April is the fourth month of the year. The variable weather of its 30 days, with sudden showers and sunshine, has given an added meaning, and April is sometimes a synonym for fickleness. So the poet William Watson says:

April, April,
Laugh thy girlish laughter;
And the moment after,
Weep thy girlish tears!

On the first day of the month of April it is not safe to pick up a bundle or a purse from the pavement, for if you do, you'll find it worthless and be called an "April fool." The custom of playing tricks on this day is so old that its origin has been lost. India from time immemorial has had its spring festival of Huli, ending March 31, in which tricks and pranks play a large part. In France such a custom was in practice in the 16th century. There the victim was called an "April fish"; in Scotland, the name used is "April gowk."

AQUARIUM. Through the broad windows of such aquariums as the world-famous one at Naples, you look from the darkened corridors into huge tanks of shimmering water, with light coming from an invisible source above. The sights that you see make you think you are in Neptune's palace at the bottom of the sea. Before you are the delicate white or pink tracery of living tropical corals, the waving red lace-work of sea-fans, the greens and browns of kelp and algae. Among these polyps and sea plants swim fishes of every shape and color. Here is one as round and vivid as a Chinese lantern, another as transparent as a piece of wriggling glass. Nearby is a gaudy swimmer with a hideous head and a delicately beau-

tiful tail, as long and thin as a gossamer veil. Peering into a dark rock cave, you meet the ugly stare from the eyes of a big octopus, whose black tentacles fade off into the shadows; while near him paddles an awkward hook-nosed sea turtle, which the octopus knows he cannot harm. Strange snails and slugs crawl about on the stones, and anemones flash their brilliant hues as they comb the nearby water for food.

One tank is kept warm for guests from the China seas, another is freezing cold for visitors from the Arctic. Care also must be shown in keeping in separate tanks the strong from the weak, or the whole scene would quickly end in tragedy. In Battery Park, in New York City, is a similar aquarium which contains many and varied specimens of this marvelous sea life.

How to Make a Home Aquarium

On a smaller scale, any intelligent boy or girl can have a home aquarium, but its preparation and management, whether fresh-water or marine, requires careful and skilled attention. If the animals are overcrowded, or if the water is allowed to get too warm or too foul, or if too few plants are provided to furnish the necessary oxygen, a few hours will convert a thriving aquarium into a chamber of horrors by killing all the occupants.

Both plants and animals must be kept in the tank, because the fish use up oxygen in the water and throw off carbonic acid gas, while plants, on the other hand, use up carbonic gas (carbon dioxide) and throw off oxygen. In well-kept aquariums the proper proportion of plant and animal life is carefully maintained, so the plant life will produce enough oxygen for the fish and at the same time use up the carbonic gas in the water. It is necessary also that the aquarium be in a light place, as darkness promotes the growth of parasites harmful to fish life, and plants give off oxygen only under the influence of light. The tank must, however, not be in the direct rays of the sun, for direct sunlight overheats the water and thus kills the animal life. Many a collection of goldfish in the usual round glass globe has been killed in a few hours by exposure to sunlight. The curved glass focuses the rays of the sun and soon scalds the fish to death. Sufficient room must also be provided. Each fish three inches long requires at least a gallon of water.

The sides of the best aquariums are of plate glass so that the fish may be seen from both sides and the top. The frame is of metal and the bottom of metal, slate, or marble, covered with sand and pebbles.

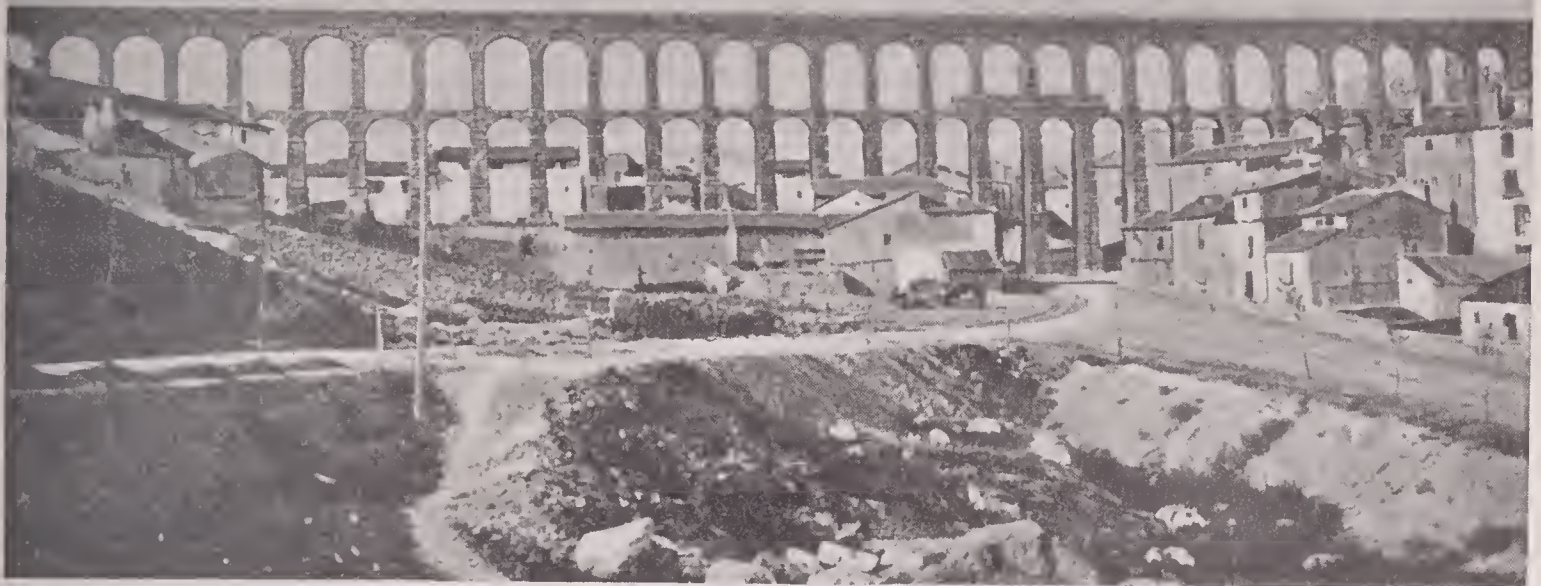
The most convenient size for a home aquarium is one holding from three to eight gallons. A five-gallon tank will provide room enough for three or four fish not more than three inches long, four or five of the acrobatic little water newts, three or four small tadpoles, six or eight snails, and two or three clams. Wholesale drug houses usually stock rectangular or cylindrical glass tanks that will be more satisfactory than a home-made tank, because it is next to im-

possible to make one that will not leak in course of time. Examine the sides carefully to make sure the glass is of good quality, so that it will not distort objects.

To stock it you will need to make a couple of trips to some nearby pond. Get your plants the first time

their nests and hatch their young as freely as in their natural surroundings, but you had better put in only a single pair because they get very quarrelsome, especially with their own species, when they breed (see Stickleback). Goldfish, minnows, and Prussian carp are also good aquarium fish (see Goldfish).

STILL CARRYING WATER AFTER NEARLY TWENTY CENTURIES



The Roman aqueduct at Segovia, Spain, is still carrying water for the people of Segovia, after nearly 20 centuries. Segovia used to be a Roman pleasure resort, and this aqueduct is said to have been built in the reign of Trajan. It is still in excellent condition. It is built of granite blocks cut from the neighboring mountains, laid without lime or cement. The value of the arch, which the Romans were the first to employ extensively, is strikingly shown in this structure. Notice that there are two tiers of arches, one above the other. Some of them are 94 feet high. The bridge portion of the aqueduct, where it crosses the valley, is more than 800 yards long, or about a half mile.

and leave the fish for another trip. The most useful plant is the *fontinalis* or water-moss that grows on decayed logs or on stones in the beds of streams. Milfoil, hornwort, eel-grass, water thyme, pond weed, stoneworts, and the tiny *algae* are all good. Any pond should provide three or four of these plants. If you can do so conveniently, take home enough of the pond water with you to fill the tank.

Now put about two inches of coarse gravel in the bottom of the tank. Wash it first so that it will not muddy the water. A few bits of rock may be put in, or an elaborate piece of rock-work, if you want to go to the trouble. When you have filled the tank with water, anchor the roots of the plants in the gravel, or if they fail to take hold, weight them down with something heavy. Don't put in too many; three or four vigorous plants are enough. Leave the plants to get used to their new home before putting in the animals. When the plants are normal you will see bubbles of air rising from them.

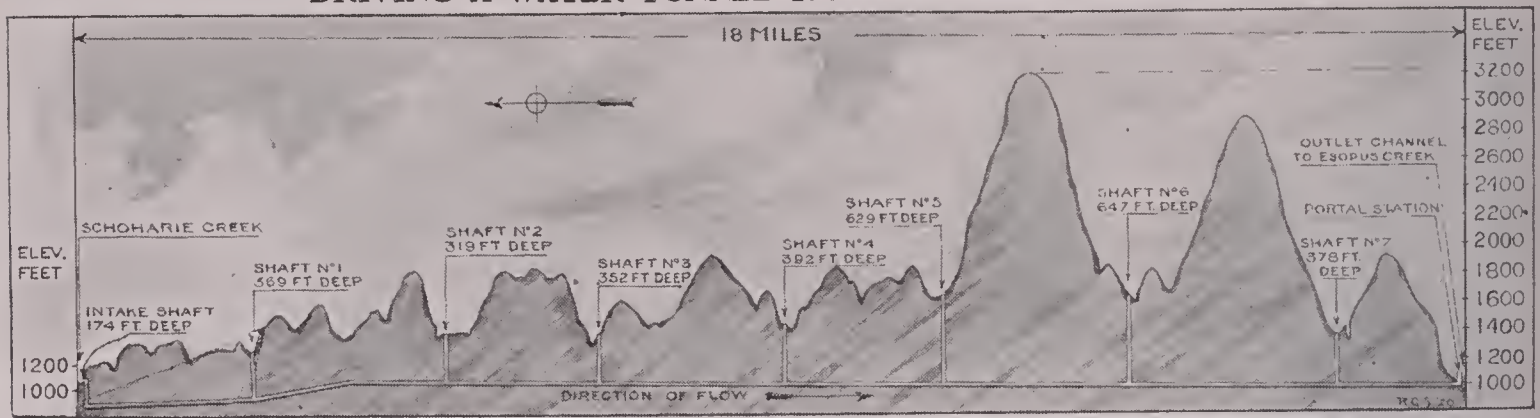
Be sure to include a few of the snails found among dead leaves on the edges of ponds and ditches, and also some of those that live in the slime-covered corners. The former will clear your aquarium of the dead leaves of water plants and the latter will keep the sides and surface free from scum. Sticklebacks are interesting little fish to keep, as they will build

Bits of meat make good food for the tadpoles, and the fish will eat bread-crumbs and insects, but they get most of their diet from small organisms in the water. If pieces of food accumulate on the bottom, remove them by lowering into the tank a glass tube, pressing your thumb over one end until it is immediately over the object. Lift the thumb, and the water with the refuse will rise in the tube and can be lifted out by closing your thumb over the end again. Keep the level of the water constant, and if you have the right balance between animals and plants it will rarely need to be changed. Sometimes turbid unhealthy water can be purified by dipping it out and pouring it slowly back. This mixes air with it.

Those who live near the seashore can make a salt-water aquarium in the same way, using oysters, mussels, sea clams, shrimps, barnacles, and sea minnows for the animals, and sea lettuce and other seaweeds for the plants. When the water evaporates add fresh water, never sea water, for the salt does not evaporate and if you kept adding sea water you would soon get a brine that would kill all the plants and animals.

AQUEDUCTS (*ăk'wē-dŭcts*). Even more striking than the web of great stone-paved roads with which the Romans bound together their empire were the giant aqueducts built to bring water to their cities.

DRIVING A WATER TUNNEL THROUGH THE CATSKILLS



In order that New York's thirsty millions may have plenty of pure water, engineers began work in 1917 on a stupendous new rock-hewn aqueduct through one of the Catskill ranges. This new tunnel, 18 miles long, was needed to double the supply of the Ashokan reservoir, so that the great 92-mile Catskill Aqueduct (described in the text) may be fed to its full capacity of 500 or 600 million gallons a day.

The city of Rome had 11 such aqueducts, built at different times, some with several channels, one above another, and ranging in length from a few miles to more than 60 miles. The conduits were built for

A STEEL-PIPE SIPHON



Six miles of the Catskill Aqueduct consists of so-called inverted siphons, which are huge steel pipes following the curves of valleys. Notice how the big pipes are first laid on cradles of concrete. Later they are lined with cement mortar and covered outside with concrete and then with an earth embankment.

the most part of masonry lined with Roman cement, and some of the aqueducts are still in use. Since the water flowed entirely by gravitation, the grades were carefully surveyed. Here an aqueduct winds gracefully around the side of a hill, there another pierces boldly through by means of a tunnel, while across the low plains near the city itself stalk giant arches holding aloft the channel for the precious water high

in the air. At Nîmes in France and Segovia in Spain are still to be seen such aqueducts intact, with double or triple rows of arches, one row on top of another, to lead the level channel across a river or deep valley.

After the fall of the Roman Empire, it was not until the middle of the 18th century that aqueduct-building was resumed to any great extent. One of the chief differences between ancient and modern structures is that the modern engineer, with high explosives and modern machinery, usually finds it quicker and more economical to build a tunnel for his water conduit. The application of the principle of the siphon, and the use of great pumping engines, frees him also of such complete dependence on gravitation to bring the water to the city.

Many modern cities are now supplied with water by aqueducts, and a large number of water-power developments and irrigation projects also use such structures. New York City is furnished with water by several aqueducts. The old Croton Aqueduct (completed in 1843) and the new Croton (completed in 1890) both bring water from the Croton Reservoir 41 miles north of the city.

The great Catskill Aqueduct (completed in 1917) is the most remarkable water tunnel ever built. It is designed to carry between 500 and 600 million gallons of water a day from the Catskill Mountains, 92 miles north of the city limits. It runs under the Hudson River and is built at that point over a thousand feet below the surface of the river. At Madison Square, in New York, the tunnel lies in rock more than 200 feet beneath the surface. The tunnels vary from 11 to nearly 17 feet in diameter and are all lined with concrete.

Los Angeles, Calif., is supplied with water by an aqueduct 233 miles long—the longest in the world—which brings water from the Owens River in the heart of the Sierra Madre Mountains. It supplies more water than the city needs, so the surplus is used for irrigation, and the great fall in its course supplies water-power.

Other important aqueducts are those used for carrying canals across rivers and valleys. The chief examples in the United States are those on the Erie Canal, 32 in number. The word aqueduct comes from

the Latin *aqua* meaning "water," and *ducere* meaning "to lead." (See Waterworks.)

ARABIA (ā-rā'bī-ā). Do you know that this peninsula of southwestern Asia is larger than all that part of the United States which lies east of the Mississippi River; that there is not one real river in the whole length and breadth of it; that it was the earliest home of the Semitic race; that it gave to the world Mohammedanism, a religion which has spread to the four

practically never falls. The plains along the coast, which receive considerable rainfall, are fertile and productive, and the same is true of many mountain valleys of the southwestern portion—the *Arabia Felix* ("Fortunate Arabia") of the ancients. There are no extensive forests, but here and there throughout the peninsula there are considerable grasslands which furnish excellent pasture for horses. For centuries the Arabian horses have been the most famous in the world. Large numbers of camels, sheep, goats, and cattle are also raised. Dates, coffee, bananas and other fruits, coconuts, spices, drugs, gums, sugar, and cotton are the chief vegetable products.

Trade is carried on chiefly by caravans. A railway, however, has been built from Damascus to Medina and is planned to carry pilgrims even to Mecca, the most holy city of the Mohammedan faith.

One-seventh of the population of Arabia are "Bedouins." This term means "dwellers in the desert," and is applied to all Arabs who lead a wandering life. They are herdsmen and at times robbers, and recognize little law except tribal custom. One or more families form the core of a tribe, a kind of aristocracy, and from their number

a superior *sheik* is chosen to lead them and to judge between those engaged in disputes, if they choose to come to him. They manufacture their own woolen clothes, and their food is mainly obtained from their herds, though they also eat rice, honey, and on occasion locusts and even lizards.

The history of Arabia really begins with the

THE LAND OF ARABIA AND ITS AGE-LONG ASSOCIATIONS



What a panorama unfolds itself to our view in this map! Here we see Mecca and Medina, the holy cities of Islam, and Mocha, which sends us our finest coffee. Not far from the northern border are Damascus and Bagdad, the enchanted cities of the 'Arabian Nights'; and in Mesopotamia, northwest of the Persian Gulf, are the ruins of ancient Babylon, once the world's most splendid capital. Notice how the entire western coast has been separated from the rest of Arabia and made into the new Kingdom of Hejaz, as a reward to the Arabs who fought so valiantly for the Allies in the World War.

corners of the earth; and that it is the original home of the coffee bean, and still produces the purest bred horses in the world? All these are facts which entitle Arabia to something more than a passing interest.

The greater part of the interior of Arabia is composed of arid tablelands and vast sandy deserts, parched by hot dry winds. In certain districts rain

A VALLEY IN ARABIA AND ITS TERRACED FIELDS



This is a typical valley in Arabia, which, the map on page 165 shows, is often mountainous. While the greater part of it is desert, there are many fertile valleys, especially in the southwest. What appear to be bushes along this little river are really good sized trees. Along the bank are cultivated terraces. The Arabs, following the practice of peoples where land is scarce and therefore very precious, have carefully cut and leveled the hillsides to form a series of steplike fields.

Prophet Mohammed, who died in the year 632 A.D. He gave the Arabs a new religion in place of their former idolatry, and sent them forth to far-reaching conquests. Syria, Egypt, and Persia were overcome, and Mohammedan rule spread over northern Africa and into Spain. Damascus and Bagdad became the centers of an Arabian civilization which boasted an extensive and poetic literature, an enlightened philosophy, and an advanced agriculture and industry.

The coming of the barbarian Turks from central Asia, in the 13th century, gradually ended this period of prosperity. From 1517 on, Arabia for the most part was under Turkish rule. The southeastern portion centering about the town of Muskat was for a time a Portuguese colony, and then was under native independent rulers. At the entrance to the Red Sea at Aden, and for some distance eastward, the British established a hold which they still maintain. In addition there were frequent

and serious revolts of the Arabs against Turkish rule. When the World War came (1914-1918), the Arabs renewed their revolts, and because Turkey was an ally of Germany, Great Britain and France aided

them. The ruler of the chief district of western Arabia was encouraged, in 1916, to proclaim his independence of Turkey, with the title "King of Hejaz." His troops valiantly aided the British in driving the Turks and Germans from Palestine and Syria, and in the peace conference which followed Arabia was fully and finally freed from Turkish rule.

The Arabian peninsula projects in a southeasterly direction from Syria and Mesopotamia to the Indian Ocean. It is separated from Egypt on the west by the Red Sea

and Suez Canal, and from Persia on the east by the Persian Gulf, and the Gulf of Oman. Its extent from north to south is about 1,500 miles; east to west, 800 to 1,200 miles; area, about 1,250,000 square miles; population, about 6,000,000. The most important political division is the new Kingdom of Hejaz, which extends along the Red Sea

WOMEN OF ARABIA

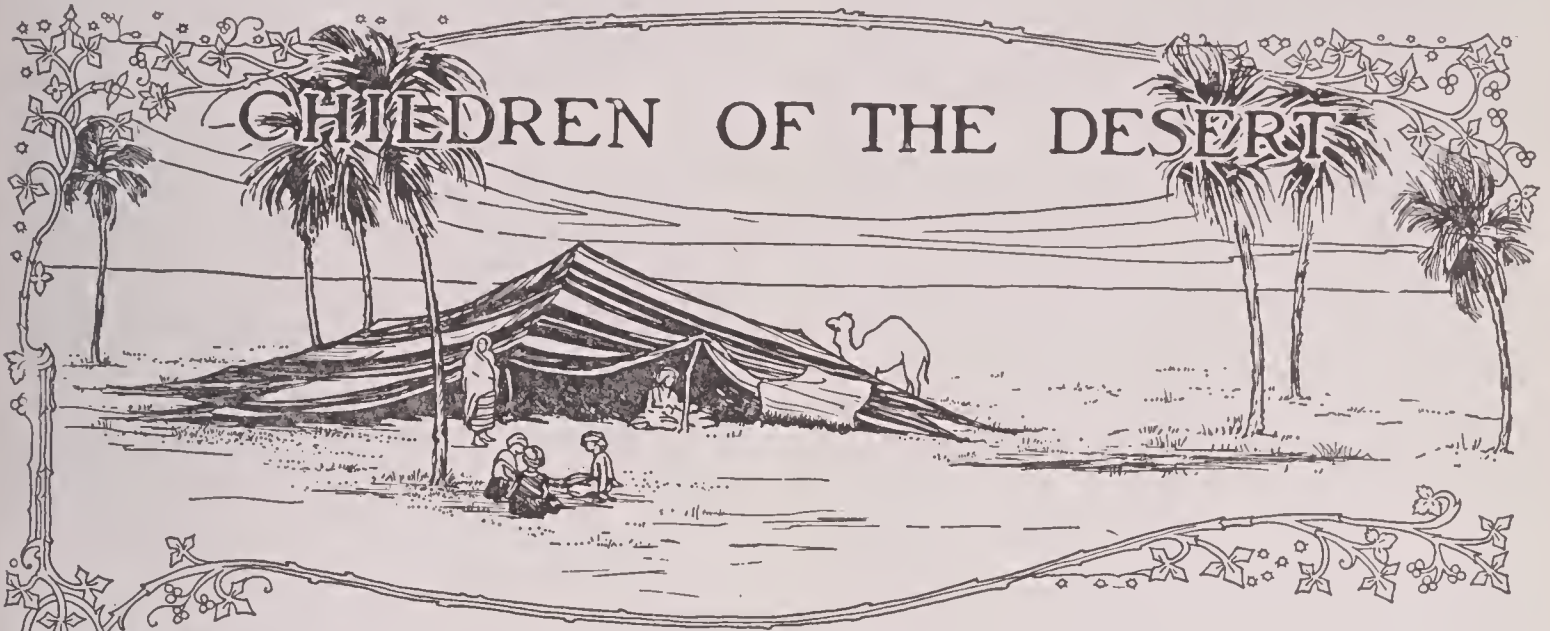


Some of the Arabian women of the towns, as you see, are just as modern in their dress as women in England or America. These are the daughters of prosperous merchants and have adopted European clothes. The court in which they are standing is, according to a common Oriental custom, paved with marble laid in mosaic. Many of the daughters of well-to-do Arabs are educated in France.

from a point a little south of Meeea to Syria, with an area of about 100,000 square miles. The chief foreign power in Arabia is Great Britain, which by its possession of the important naval base of Aden, in the southwest corner (see Aden), controls the entrance to the Red Sea, and by its protectorate over Koweit, at the head of the Persian Gulf, controls the terminus of the Bagdad Railway. Between

Hejaz and Aden are two little independent governments, the Principate of Asir and the Imamate of Yemen. The chief port of the latter is Mocha, from which immense crops of coffee are exported. In the southeast corner bordering on the Persian Gulf and the Gulf of Oman is the Sultanate of Oman, famous for its pearl fisheries, and the richest part of Arabia in both agricultural and mineral wealth.

CHILDREN OF THE DESERT



DON'T you want to go on a journey to see some children who live in a desert? They live very differently from any people that you could find anywhere else in the world. They have two things you like very much—no, three. They have sugary dates to eat, big humpy camels and dromedaries to ride,

and 'Arabian Nights' stories to listen to in the evenings beneath the stars.

If you want to see little Mehemet and Zaidee in their tent home in Arabia, you must call upon them very early in the morning or after the sun goes down. From noon until four or five o'clock, while the burning sun blazes on the desert sands, there seems to be no one stirring about the big tent. The tent is quite 40 feet long, because the father of these children is a sheik, or Arab chief. It is covered with brown camel's hair cloth, or with goat skins.

It stands on a few acres of grass under some tall date-palm trees beside a spring. The spring makes a green spot in the desert, an oasis. All around that green oasis are miles and miles of dry sand. The sand dazzles your eyes, so you think you see other oases and palm trees and blue water. But these are only air pictures that fade away (see Mirage). The sand is blown up by the wind in great drifts,

like snow. In the shadows of these drifts and of big rocks, camels and sheep and goats lie asleep. The herders and sheep dogs are asleep among them.

If you should lift the door flap of the tent you would see a white curtain hung across the middle. This divides the big tent into two rooms. The men and boys are in one room, and the women and girls in the other. It is dark and cooler inside the tent.

You must step softly, for everyone is asleep. They lie on colored mats and saddlebag cushions. These are made of Oriental or Eastern rugs. Americans

AN ARAB AT A PUBLIC WATERING PLACE



Water is so scarce in Arabia that the wealthy Arabs consider that one of the things most pleasing to Mohammed, the author of their faith, is to establish public watering places such as the one you see here, beside which the Arab is resting and enjoying his long-stemmed pipe. Do you wonder that he loves that horse?

buy these rugs for their very best rooms if they have enough money. The Arab chief buys them in the Turkish city where he goes to sell his camels and his wool. He has had to pay a good deal for them, but they will wear several lifetimes. Besides, they are the only kind of beds and seats he can carry with him. He has to move about a good deal, to find food and water for his animals.

Every one is asleep but Saladin, the master's Arabian horse. Saladin stands beside his sleeping master in the tent. He is slender and dainty. His coat is like black satin. He holds up his proud head on his arched neck. He stamps his little polished hoofs on the sand. Saladin is the family pet. He is very gentle. He skims over the desert like a bird with his master on his neck, and has wonderful power of endurance. Mehemet gave him some dates to eat before he went to sleep. Zaidee kissed his black nose.

At sunset a cool breeze blows across the desert. Everybody wakes up. Mother brings her loom, and sits on a mat outside the tent to weave camel's hair cloth. The herdsmen milk the camels and goats. A servant woman makes Mocha coffee. It is the best coffee in the world, and is grown in Arabia. The children drink goat's milk. They all eat crisp bread made in cakes like our crackers. It is made of wheat, barley, or millet seed flour, and is baked on hot stones. They eat a stew of goat's flesh or mutton. For dessert they eat dates and perhaps almonds.

Why Pretty Zaidee is So Dark

Zaidee is very pretty. She would not be so very dark but the hot sun has burned her as brown as a gypsy. Her hair is black and straight. Her soft eyes are the color of brown velvet. She wears wide trousers and a loose gown of blue cotton. On her head is a blue cloth, bound into a long-tailed bonnet-cap, with a band of goat's hair. She has copper and silver bracelets on her arms and ankles, and strings of glass beads. Her brother wears a long white shirt with a leather girdle, and a white cotton bonnet bound with goat's hair. When they walk on the sharp hot sand, they both put on leather sandals. The father wears a white turban made of many folds of thin stuff wound around his head. He smokes a pipe.

Sometimes, as the family sits in the starlight, the father or mother tells stories like those you read in the 'Arabian Nights'. The Arabs with their poetic imaginations have made up the most wonderfully colored and fanciful stories of any people in the world. Their stories are full of the splendors of palaces and princes. They sparkle with jewels and are woven of magic. The children of every people in the world listen to these stories with wide wondering eyes. Perhaps, too, that is why the desert people love the many-colored, gaily patterned rugs. Spread on the sand they look like flower beds.

As soon as the moon is up, the herders take down the big tent. The water is dwindling in the spring, the grass is almost gone. The family must move to a better pasture. They must go at night, when it is

cool. Everything is packed on the kneeling camels. Skin bags are filled with water, and bread and dates are made ready for the journey. One by one the animals take a last drink at the spring. The camels fill the little water pockets in their stomachs, to last for several days.

Saladin, the proud bearer of his long-bearded, white-turbaned master, leads the procession. Then come the women and children on the riding dromedaries. The freight camels follow with their drivers; the brown herders and dogs drive the sheep and goats. The moon is a silver crescent in the dark blue sky. The stars are little high, white lamps. The padded feet of the camels make no sound. They swing and rock like ships across the sea of sand. Perhaps that is why camels are called ships of the desert.

The procession grows smaller and dimmer in the distance. Now it goes over a great ridge of drifted sand and disappears. Mehemet and Zaidee are gone. But you will never forget this vast plain of white sand under the clear blue sky. It lies there so wide and silent and lonely, under the silver light of the moon and stars.

'ARABIAN NIGHTS'. A sultan of the Indies who was disappointed in love had made a vow to take a new wife every day and put her to death the following morning. To stop this cruel practice Scheherazade (*she-hā-rā-zā'de*), the beautiful daughter of the grand vizier, becomes the sultan's bride. She is a gifted narrator of stories and arranges for her sister to come before dawn and beg that she be permitted to tell one last story before her execution. This is done, and Scheherazade breaks off her tale at so interesting a point that the sultan spares her life until the next night, in order that he may hear the story's end. So it continues for a thousand nights. Meanwhile Scheherazade bears the sultan a son. Presenting him to her lord, she tells him of the craft she has used, and the sultan, who has grown to love his wise and beautiful bride as well as to look forward to her stories, abandons his vow and lets her live.

This, in a few words, is the framework of 'The Arabian Nights, or Tales of the Thousand and One Nights', the most famous book in Arabian literature. It has been translated into many languages, and has probably been read more than any other book of tales ever written. The stories of Aladdin and his Wonderful Lamp, of Ali Baba and the Forty Thieves, of Sinbad the Sailor and the Old Man of the Sea, with their incidents of adventure, of magic, and boundless treasure, are among the most prized possessions of literature.

The basis of the collection was translations of tales from the Hindu through the Persian. To those were added many other stories originating in Bagdad and in Egypt. Many of the tales deal with the times of the great Calif Harun-al-Raschid (786-808), the contemporary of Charlemagne. They all have value for the light which they throw upon Arabian civilization at its highest point.



THE STORY OF ALADDIN AND THE WONDERFUL LAMP

LONG long ago there lived in the capital of China a young boy, Aladdin, the son of a very poor widow. One day as he played in the street with his companions, a stranger who was passing stopped and spoke to him. "Child, was not your father called Mustapha the tailor?" he asked.

"Yes, sir," answered Aladdin, "but he has been dead a long time."

At these words the stranger threw his arms about Aladdin's neck, kissed him several times, and with tears in his eyes said:

"I am your uncle; your worthy father was my own brother. I knew you at first sight, you are so like him."

He then gave the boy a handful of money, saying:

"Go, my son, to your mother. Give my love to her and tell her that I will visit her tomorrow, that I may see where my good brother lived so long and ended his days."

Aladdin's mother was much surprised to learn that her husband had a brother, but she rejoiced with her son at the good fortune which had come to him, for the stranger promised to buy Aladdin a shop, and to dress him as handsomely as the best merchants in the city.

Early the next morning the stranger called to take Aladdin into the country to spend the day. After walking some distance they reached a narrow valley between two mountains. Here Aladdin's companion paused and bade him gather up all the dry sticks he could find. These the stranger set on fire. Then, pouring some incense into the blaze, he pronounced several magical words, and immediately the earth opened, disclosing a stone with a brass ring fixed in it. Aladdin was greatly frightened, and would have run

away; but the stranger caught hold of him and said: "Do not be afraid. Under this stone there is hidden a treasure destined to be yours, and which will make you richer than the greatest monarch in the world. Take hold of the ring and lift up the stone."

Aladdin did as he was told; and there appeared under the stone a staircase leading down to a door.

"Descend those steps, my son, and open that door," said the stranger. "It will lead you into a palace divided into three great halls. Before you enter the first hall be sure to tuck up your robe and wrap it about you, for if your clothes so much as touch the wall you will die instantly. Then pass through the second and third halls without stopping. At the end of the third you will find a door which opens into a garden, planted with fine trees loaded with fruit. Walk directly across the garden to a terrace, where you will see in a niche a lighted lamp. Take the lamp down and put it out. When you have thrown away the wick and poured out the oil, put it in your waistband and bring it to me."

The stranger then drew a ring off his finger and putting it on one of Aladdin's said: "This is a talisman against all evil, so long as you obey me. Go, therefore, boldly, and we shall both be rich all our lives."

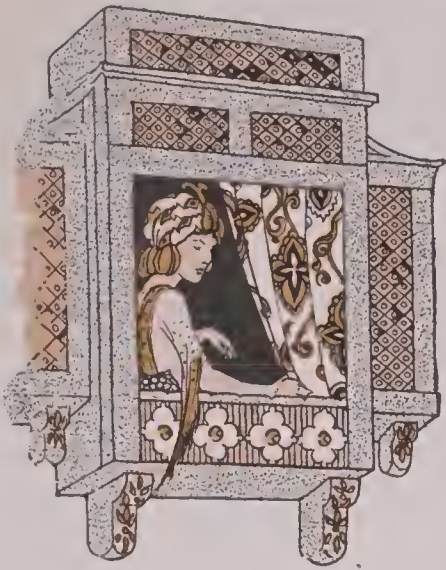
Where Jewels Grew on Trees

Aladdin followed the stranger's instructions; but as he was returning with the lamp, he noticed that the fruit of the trees was composed of what he imagined to be colored glass, though in reality these bits of glass were beautiful jewels of every description. He filled his purse and his skirts with them; and, loaded with riches of which he little realized the value, he returned to the mouth of the cave and cried out: "Pray, uncle, lend me your hand to help me out."

The stranger, however, insisted that Aladdin give him the lamp first. But the latter whose hands were filled with jewels refused. At that the stranger flew into a passion, threw some incense into the fire, and spoke two magical words—at which the stone rolled back into place, imprisoning the boy in the gloomy cave.

Aladdin then realized that the stranger was no uncle of his, but a wicked magician who designed him evil. And this indeed was true, for he was known as the African magician, and had come from his native land for the express purpose of obtaining the magic lamp. An oracle had revealed to him its whereabouts, and had further stated that the lamp must be given to him as a gift from the hands of another if he would obtain favors from it. It was for this reason that he had prevailed upon Aladdin to secure his prize.

Aladdin's cries for help echoed and re-echoed through the dark cave, unheard by anyone. Worn out at last he joined his hands to pray, and in doing so rubbed the ring which the magician had placed on his finger. Immediately there rose from the earth a frightful *Jinn* or spirit bearing a torch in his hand, who said:



"What wouldst thou have? I am ready to obey thee. I serve him who possesses the ring on thy finger; I, and the other slaves of the ring."

Although greatly frightened, Aladdin replied "Whoever thou art, deliver me from this place."

No sooner had he spoken than he found himself

on the very spot where the magician had left him, while no sign of the cave remained. He quickly made his way home, and after relating to his mother all that had happened he asked for some food.

"Alas, child," she replied; "I have not a bit of bread in the house, nor have we money to buy any."

Aladdin thereupon suggested selling the lamp, and his mother agreed, but wished first to clean it. No sooner had she begun to rub it than there appeared another hideous Jinn who roared in a voice of thunder:

"What wouldst thou have? I am ready to obey thee as thy slave, and the slave of all those who have that lamp in their hands."

Greatly terrified, Aladdin's mother fainted; but Aladdin quickly seized the lamp and said boldly: "I am hungry. Bring me something to eat."

The Jinn disappeared, and presently returned bearing a large silver tray holding 12 covered silver dishes filled with delicious food, two flagons of wine, and two silver goblets. In their humble cottage the mother and son then partook of a feast fit for a king.

In spite of the fact that they had an inexhaustible source of riches in the lamp, and that Aladdin had come to realize the value of the "glass stones" which he had brought home, he and his mother continued to live very simply. One day, however, as Aladdin was strolling about the town he chanced to see the beautiful Princess Buddir al Buddoor, the daughter of the sultan. Charmed by her grace and beauty, he fell deeply in love with her, and resolved to win her in spite of his humble station.

Hastening home, he commissioned his mother to take all his jewels as a gift to the sultan and ask of him the hand of the Princess for her son. The sultan was amazed at the beauty of the gems, and replied without hesitation:

"Go tell your son that I wait with open arms to embrace him; and the more haste he makes to come and receive the Princess, my daughter, from my hands, the greater pleasure he will do me."

Aladdin, overjoyed at his mother's success, summoned the Jinn of the lamp and said:

"Jinn, build me a palace of porphyry, jasper, agate,

lapis lazuli, and the finest marble. Let its walls be of massive gold and silver bricks, and let the lattices of the windows be enriched with diamonds, rubies, and emeralds. Let there be an inner and an outer court, and beautiful gardens. But above all things provide a safe treasure-house and fill it with gold and silver. Let there be also kitchens and storehouses, stables full of the finest horses, with their masters and grooms, and hunting equipage, officers, attendants and slaves, both men and women, to form a retinue for the Princess and myself."

The next day the marriage was celebrated with great splendor and ceremony, and Aladdin led his Princess to the wonderful palace built overnight by the Jinn.

Several years later the magician, who had returned to Africa after imprisoning Aladdin in the cave, decided to learn whether Aladdin had perished. He set out for the capital of China and soon after arriving learned of the boy's wealth and happiness. Filled with rage, he bided his time until Aladdin one day went hunting. Then purchasing 12 bright new lamps, he walked past the palace crying:

"New lamps for old! Who will exchange old lamps for new?"

The Princess, who heard him, sent one of her slaves to fetch an old lamp which she had noticed in her husband's robing room, and bade her exchange it for a new one. Little did she realize that this old lamp was the source of all their wealth and prosperity! The magician snatched the lamp eagerly, summoned the Jinn, and ordered the palace and all its occupants to be transported into the heart of Africa.

The Princess, the Palace, and All!

Aladdin was frantic when, upon his return, he learned that his palace and his Princess had disappeared with a clap of thunder. The sultan, very angry at the disappearance of his daughter, at first ordered Aladdin put to death; but he finally agreed to allow him 40 days in which to find her. In his grief Aladdin forgot the magic ring upon his finger, until he accidentally rubbed it, whereupon its attendant spirit appeared.

"Transport my palace to the place where it first stood," commanded Aladdin.

"Only the Jinn of the lamp can do that," replied the spirit.

"Then I command thee, by the power of the ring, to transport me to the spot where my palace now stands."

At once Aladdin found himself in the presence of Princess Buddir al Bud-



ALADDIN AND THE BEAUTIFUL BUDDIR AL BUDDOOR



"One day as Aladdin was strolling about the town he chanced to see the beautiful Princess Buddir al Buddoor, the daughter of the sultan. Charmed by her grace and beauty, he fell deeply in love with her, and resolved to win her in spite of his humble station."

contained in the Easy Reference Fact-Index at the end of this work

door, who told him all that had befallen. Learning that the wicked magician kept the lamp always in his waistband, Aladdin formed a plan for its recovery. He had the Princess invite the magician to dine with her that night. Then, purchasing a powder which would mean instant death to anyone who swallowed it, he gave it to the Princess to put in her guest's wine goblet. Aladdin hid under the table during the repast, and as the magician drank his wine and instantly fell forward senseless, he sprang out, snatched the lamp, and quickly rubbed it.

"Jinn," he cried, "I command thee to transport this palace instantly to the place from which it was brought hither."

Immediately the palace and its occupants were carried back to China. There joy and gladness succeeded grief and mourning at court, and the happy sultan, as he embraced his daughter, begged Aladdin's forgiveness for his distrust of him.

Within a few years the sultan died at a good old age, and since he left no male children, the Princess Buddir al Buddoor succeeded him, and she and Prince Aladdin reigned together in great prosperity for many years.—*Retold from 'The Arabian Nights'.*

AR'AL, SEA OF. With the exception of the Caspian Sea, about 150 miles to the east, the Sea of Aral is the largest body of water in Asia. Indeed, it is one of the largest inland bodies of water in the world, its area (about 26,000 square miles) being somewhat larger than that of Lake Michigan. Geographers believe that it was much larger at one time, and was connected with the Caspian. The water is slightly salt, but the fish belong to fresh water species. Its two tributaries are the ancient Jaxartes (Syr-Daria) and Oxus (Amu). The shores are practically uninhabited, owing to the fact that it is almost entirely surrounded by steppes, rocky plateaus, and swamps. In spite of its comparative shallowness, navigation is made dangerous by violent storms.

ARBITRATION. Two neighbors quarreled over the boundary between their farms. One claimed that the fence belonged just where it was. The other contended that it was on his land, and should be moved over two rods in his neighbor's direction. Bitter words passed between them. Finally one took the matter into court, where each presented his claims and a jury decided the matter.

Two nations—the United States and Mexico—quarreled over the boundary between their lands. The United States claimed that the dividing line was the Rio Grande, while Mexico contended that it was the Nueces River, some hundred miles to the eastward. Bitter messages followed, and finally the two nations engaged in a war which cost thousands of dollars and hundreds of lives, to determine where lay the boundary.

About 50 years later two nations—this time Great Britain and Venezuela—were involved in a quarrel over the dividing line between Venezuela and British

Guiana. Each side meant to take the territory it claimed, but just when war seemed inevitable, Great Britain acting upon the suggestion of the United States offered to let an impartial commission made up of men from different countries decide where the boundary line should be. The claims of both countries were heard, just as in the case between the two men mentioned above, and the dispute was settled by arbitration instead of by war.

Uncle Sam as a Peacemaker

The United States has taken the lead in urging the peaceful settlement of quarrels between nations by arbitration and has frequently submitted its own disputes to the decision of arbitrators. Eighty-three disputes between the United States and some 24 different countries have thus been settled in friendly fashion by some form of arbitration. Many of these cases have been with Great Britain, and they include the settlement by arbitration of the northeast boundary of the United States, the boundary in the inlet to Puget Sound on the Pacific Coast, the conflicting interests of the two countries in the Newfoundland fisheries and the sealing in Bering Sea, and—most important of all—the *Alabama* claims (see "*Alabama*" Claims). It is said that altogether there were only 6 cases of arbitration in the 18th century, but 471 in the 19th century.

The United States has also set an example in making treaties with other countries in which each agrees beforehand to use arbitration in any disputes which may arise, before resorting to war. By 1914, when the World War broke out, such treaties had been made with more than half the nations of the world.

The cause of international peace was further advanced by the Hague court of arbitration established by the Hague Peace Conferences of 1899 and 1907. But this could act only when both parties to a dispute agreed to refer it to that tribunal. A more important step was the formation in 1919 of the League of Nations, with a constitution providing that the nations which become members *must* attempt to settle their quarrels by arbitration or other peaceful means before resorting to war, and establishing a permanent court to hear such cases. In this way we are realizing the dream of the poet Tennyson, of a time when—

The war drum throbbed no longer, and the battle-flags were furled

In the Parliament of Man, the Federation of the World.

Arbitration and the Labor Problem

Arbitration is as useful also in settling disputes between employer and employee—labor and capital—as it is in preserving peace between nations. Its use has prevented or settled many bitter strikes and saved hundreds of thousands of dollars to employers and men, and untold suffering to the wives and children of the latter. It is also a powerful weapon to safeguard the interests of the public. For instance in 1902 the anthracite coal miners asked for higher wages, and when their demands were refused they

struck. As a result, many factories were forced to close down for lack of coal, and thousands of workmen were out of work. Conditions finally became so bad that President Roosevelt forced the mine operators to submit the dispute to the arbitration of a commission which he appointed.

Australia and New Zealand have led the world in legislation which *forces* employers and employees to submit their disputes to the compulsory arbitration of courts in which both sides are represented. Heavy fines and other penalties are provided for strikes or lockouts in violation of its provisions.

ARBOR DAY. The idea of setting apart an annual day for planting trees was born on the treeless plains of Nebraska. J. Sterling Morton, who later became United States Secretary of Agriculture, realizing what value, beauty, and comfort trees would add to his state, induced the authorities of Nebraska to proclaim the first Arbor Day, in 1872. Over 1,000,000 trees were planted at that time, and April 22, Mr. Morton's birthday, was later set aside for annual repetition of such tree-planting and made a state holiday.

Arbor Day is now observed in most of the states. In many it is a legal holiday, and in others its observance is general though there is no legal enactment. The date depends on the climate of the different sections.

In addition to the planting of trees, Arbor Day is now made an occasion to impress upon the people of the nation, young and old, the responsibility that rests on them to beautify their yards, neighborhoods, parks, and public grounds. It is also intended to cultivate an appreciation for natural beauty, especially for trees, such as inspired Joyce Kilmer, the martyred soldier-poet, when he wrote:

I think that I shall never see
A poem lovely as a tree.

A tree whose hungry mouth is prest
Against the earth's sweet flowing breast;

A tree that looks at God all day,
And lifts her leafy arms to pray;

A tree that may in summer wear
A nest of robins in her hair;

Upon whose bosom snow has lain;
Who intimately lives with rain.

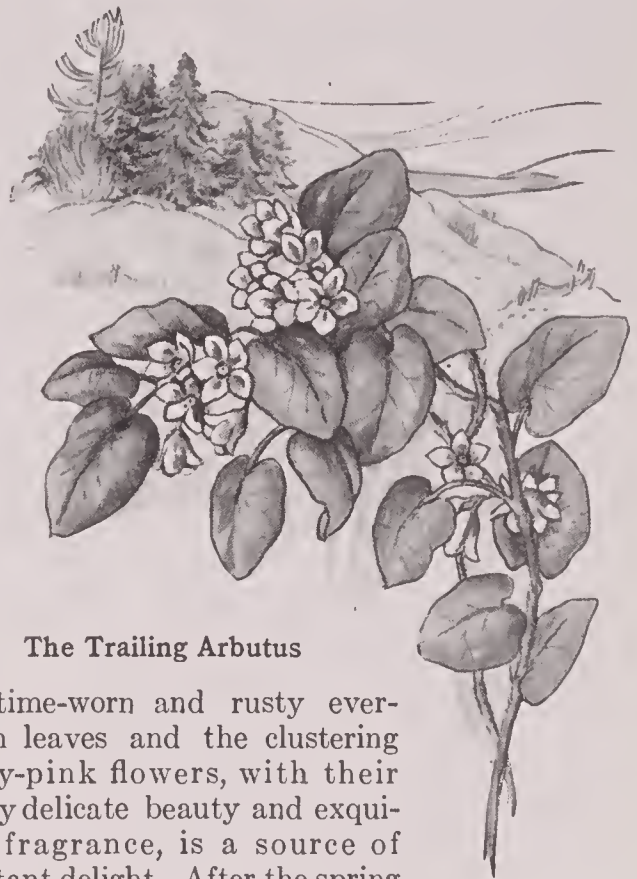
Poems are made by fools like me,
But only God can make a tree.

ARBU'TUS, TRAILING. One of the loveliest of our early wild flowers is this brave little blossom of the heath family, whose buds are formed in the fall, all ready to come forth while yet another snowstorm may be expected. It is found from the Newfoundland woods south to Florida and westward to Kentucky, abounding in the northern pine forests of the Middle West.

In New England, where the arbutus is especially loved, it is called the "Mayflower," and in the southern states the ground laurel. It thrives best in densely shaded mossy woods, where the soil is

sandy or rocky. It clings closely to the ground under dried leaves, grass, and pine needles.

At the time of blossoming, the contrast between



The Trailing Arbutus

the time-worn and rusty evergreen leaves and the clustering waxy-pink flowers, with their rarely delicate beauty and exquisite fragrance, is a source of constant delight. After the spring rains the new leaves appear and show glossy green; the finest specimens of both flower and foliage are to be found at this time.

In gathering arbutus, every true lover of nature will take care not to uproot the plant, and will pluck only a few sprays. This lovely little wild flower is growing scarcer each year, and attempts to transplant it to our gardens are almost never successful.

Whittier's poem describes the arbutus as the first wild flower to greet the Pilgrims after they landed at Plymouth:

"Yet God be praised!" the Pilgrim said,
Who saw the blossoms peer
Above the brown leaves, dry and dead,
"Behold our Mayflower here!"

Scientific name, *Epigaea repens*. Flowers have calyx of 5 over-lapping sepals, with slender hairy tubelike corolla (blossom) spreading into 5 equal lobes; 10 stamens; 1 pistil. Stem is slender, rusty-brown, leafy, and hairy. The rusty, evergreen leaves are oval, smooth above and hairy beneath.

ARCADIA. In the beautiful land of Arcadia light-hearted shepherds and shepherdesses spend all their days in joyous dance or wandering through green meadows beneath the fairest of skies. Nowhere is there misery or wickedness, and all are young and fair. For centuries poets have delighted to picture such a land, peopled by a race—

With nature pleased, content with present ease,
Free of proud fears, brave beggary, smiling strife
Of climb-fall court, the envy-hatching place.

Arcadia in this sense is a wholly imaginary country.

But in Greece, on the central plateau of the Peloponnesus, there is a real Arcadia, from which this fabled land of romance received its name. Shut off from the coast on all sides by high mountains, its people in ancient days lived simple pastoral lives untouched by the progress that marked the rest of Greece. There was no immigration, and customs and dialect remained for centuries unchanged. The name Arcadia thus came to be a symbol of ideal simplicity and happiness. Today the population remains sparse, although the district now extends to the Gulf of Nauplia and has a seacoast of about 40 miles. Much of it is forested and the soil mostly unproductive.

ARCH. Why is it that a barrel won't break as easily as a box? Why are bridges built in high curves, and why are the roofs of tunnels rounded? You know how hard it is to crack a walnut, and that you can squeeze the thin sides of an egg pretty hard before the shell crushes in, but can you tell the reason?

All this strength of hollow things with curving sides rests on a principle discovered thousands of years ago—the principle of the arch. It is used everywhere—in buildings and bottles, in electric light globes and the bottoms of ships, in almost everything which has to stand rough usage and pressure from the outside.

To understand this principle, let's consider it in one of its simplest forms—the ordinary building arch of stone, such as you often see over windows and doors.

Why don't the stones in the middle of the arch fall through? The reason is that they are wedge-shaped, and while they are forced down by the weight above them, they push against the stones next to them. These pass on the pressure to the stones on each side of the curve and to the perpendicular sides of the door or window. Each stone in this way helps to hold up every other stone. The only way the arch could fall through would be if it pushed the sides of the window or door apart. This tendency of arches to push out against their supports is called *thrust*.

Thrust may be overcome in one of two ways—either by having the arch supports so heavy that they can't be pushed over, as in the case of the window or door, whose sides are the walls of the building itself; or by making the arch one solid piece with cement or concrete, so that the stones *stick together*

and form really one big curved stone without any loose joints to give way under the side thrust.

Stone arches are usually built first over a wooden framework which holds them up until the middle stone is dropped in place. This middle stone is called the *keystone*, because it locks the entire arch.

When the arch principle is extended over an entire room or passageway, it is called a *vault*. The roof of a tunnel is a vault. If a vault is perfectly round, like the half of an orange, it is called a *dome*. In each case the same law applies. Pressure on any part of the curved surface is transmitted along the curve.

The arch has played an important part in archi-

teature since very ancient times. The Egyptians used it in their smaller buildings. The Greeks knew about the arch but made little use of it. The Romans employed it constantly in their great structures, and many of the great triumphal arches which they built as ornaments nearly 2,000 years ago are still standing.

ARCHIMEDES (*är-kī-mē'dēz*) (287-212 B.C.). "Give me a

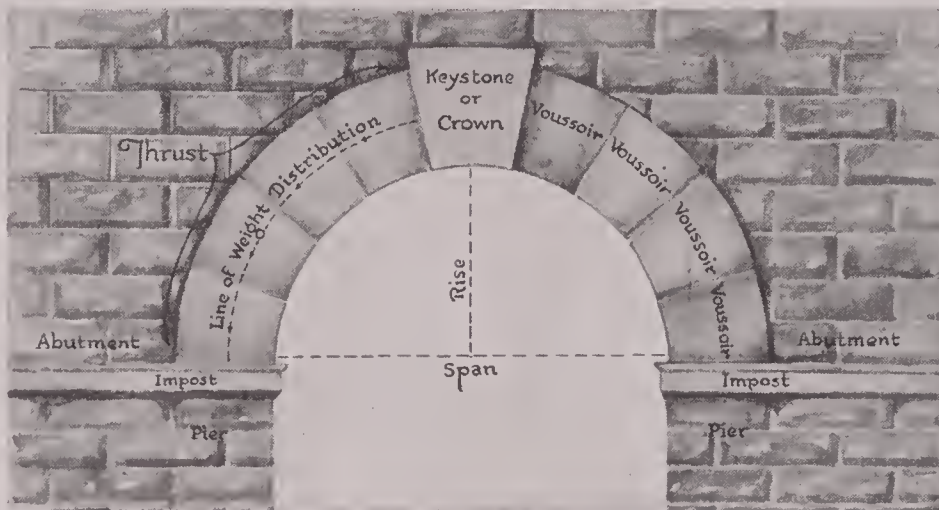
place to stand and to rest my lever on," said this ancient Greek mathematician and inventor, "and I can move the earth."

At another time, it is said, Archimedes ran naked through the streets of his native city, crying "Eureka! Eureka!"—which is Greek for, "I have found it." The ruler of that city had ordered a goldsmith to make a crown of pure gold; and suspecting that the goldsmith had cheated him by dishonestly adding alloy, he handed the crown to Archimedes and asked him to find out if this was so. Archimedes discovered the solution to the problem by observing the amount of water displaced by his own body while taking a bath. It was this observation which caused him absent-mindedly to run home, without his clothes, to try the same experiment with the crown.

Archimedes proved that the goldsmith was dishonest. At the same time he proved this principle of the science of mechanics: "That a body immersed in a fluid loses as much in weight as the weight of an equal volume of the fluid."

Not only was Archimedes the greatest mathematician and writer on the science of mechanics among the ancients; he was in addition their greatest inventor. He was the first to realize the enormous power that can be exerted by means of a lever. He also

THE KEYSTONE AND THE ARCH



Here we have pictured the construction of an arch. A "voussoir," as you can see, is of the same shape as the keystone, and a kind of "first assistant" in holding up the arch. The "abutment" is the part of the wall that receives the side thrust, while "impost" is the name given to the part of the wall from which the arch springs. Beneath it is the "pier." The greatest width of the arch is called the "span," while the distance between the span and the bottom of the keystone is the "rise."

“DON'T DISTURB MY CIRCLES!”



Even if you did not know that this is the great Archimedes, you would feel sure that the subject was some great man, wouldn't you—with that splendid head, that intellectual face, and those bent brows concentrated in thought? The habit of intense concentration on one line of thought is characteristic of all great men. An anecdote of Socrates, for example, is to the effect that he sat a whole day in the marketplace meditating on some idea that engaged his attention. It is easy to imagine then that such a man should be so absorbed in a problem that he wouldn't realize that his life was in danger, and would resent the coarse interruption of the brutal Roman soldier with, "Don't disturb my circles!"

invented the compound pulley, and a spiral screw for raising water and other substances which is still widely used and is called "Archimedes' screw." The principle of this screw is illustrated by the ordinary kitchen meat grinder, in which the wide spiral blade is inclosed in a cylinder so that whatever is put in at one end is forcibly drawn against the grinding teeth. Another example of Archimedes' great invention is found in the winding thread of a carpenter's auger. When a hole is being bored, this thread conveys to the surface and out of the way the chips and shavings cut off by the point deep down in the wood.

When Syracuse, in Sicily (his native city), was besieged by the Romans he invented new war engines for its defense, and suggested a method for using burning glasses to set fire to the besieging ships. The Romans took the city, but only after a siege of three years. Archimedes was slain in the massacre which followed. It is said that what particularly angered the Roman soldiery was that when they burst into his house, Archimedes was absorbed in contemplation of mathematical figures which he had drawn on the sand. To the soldier who interrupted him, he merely said, "Don't disturb my circles."

contained in the Easy Reference Fact-Index at the end of this work

ARCHITECTURE, *the* OLDEST *of the* ARTS



Did you know that the Great Pyramid of Gizeh was almost as tall as the Woolworth Building and far greater in bulk? But height and bulk do not measure civilization. The pyramid was built by slaves for a tyrant. The sky-scraper was built by free men for their own use. There's the progress.

WHEN you look at a great sky-scraper shooting up toward the clouds, do you ever stop to think that it typifies the rush and energy of modern life? Have you ever read in it the story it has to tell of concentrated usefulness and efficiency, of great tasks boldly undertaken and rapidly accomplished, of busy industry and trade, and steel and machinery and harnessed electricity? Someone has said that the sky-scraper "writes in letters of stone the 20th century spirit of the American nation." In this article you may read the wonderful history of man as a builder, in all ages, from the days of the ancient Egyptians down to modern times.

ARCHITECTURE.

The tendency of buildings to reflect the lives and thoughts of the people who build them has existed in all ages, and it is this combination of building-

science with fine art that we call architecture.

The building problems of the earliest savages left little room for art, for their homes were simple dens of refuge and warmth, like the caves of Cro-Magnon and the snow-huts of the Eskimo. The earliest great architecture is that of ancient Egypt and Babylonia, and it is among their ruins that our history begins.

Egyptian Monuments of Tyranny

What do those tremendous pyramids and temples left by the old Egyptians tell us? In the first place their vast size and stupendous weight of masonry show us that the architects were in the grip of a powerful awe-inspiring religion. There is no idea of shelter or daily usefulness in these structures. They are the tombs of kings and habitations for the gods. They tell us of millions of poor people ground under the heel of a monstrous tyranny—hewing great masses of granite and sandstone with small hand-chisels in distant quarries, transporting them many miles with the most primitive means, and carving and polishing them by hand into columns, gigantic obelisks, and great building blocks. "Slavery" is written in bold letters across every one of these structures. Tens of thousands of workers were born in their mud huts, grew old in bitter labor under the fierce African sun, and died, while a single pyramid was raised to gratify a proud and ruthless Pharaoh.

So there is little of delicate beauty or skilful design in Egyptian architecture. It is mostly the brute force of building, and the decoration was obtained chiefly by painting patterns in vivid colors or carving figures of heroic size on the polished stones.

Ancient Babylonia presents a similar picture, with one great difference. No stone quarries were to be found along the Tigris and Euphrates rivers, so the Babylonians had to do their building with baked or

sun-dried bricks. But they too constructed temples and palaces on a huge scale, the former in the shape of great tapering towers rising from the flat plains, the latter usually in the form of fortresses. Since the dwellers of western Asia were more exposed to attacks of their neighbors than were the Egyptians, much of their architecture consisted in building huge walls with turrets and battlements around their cities. And since bricks could be laid in more varied shapes than the unwieldy stones of the Egyptians, we find more curved and broken lines in Babylonian buildings. They made great use of the *arch*, which the architects of the Nile seldom employed in their larger structures.

The Assyrians, to the north of the Babylonians, copied the architecture of the latter on an even larger scale, and introduced stone masonry. They learned, moreover, to decorate their walls with designs of glazed brick in varied colors—an art invented by the Egyptians. Their skill in turn was passed on to the Chaldeans, or later Babylonians. These, under the great Chaldean king Nebuchadnezzar, developed the most magnificent buildings that men had ever seen, and Babylon with its temples, palaces, and hanging gardens became one of the wonders of the world.

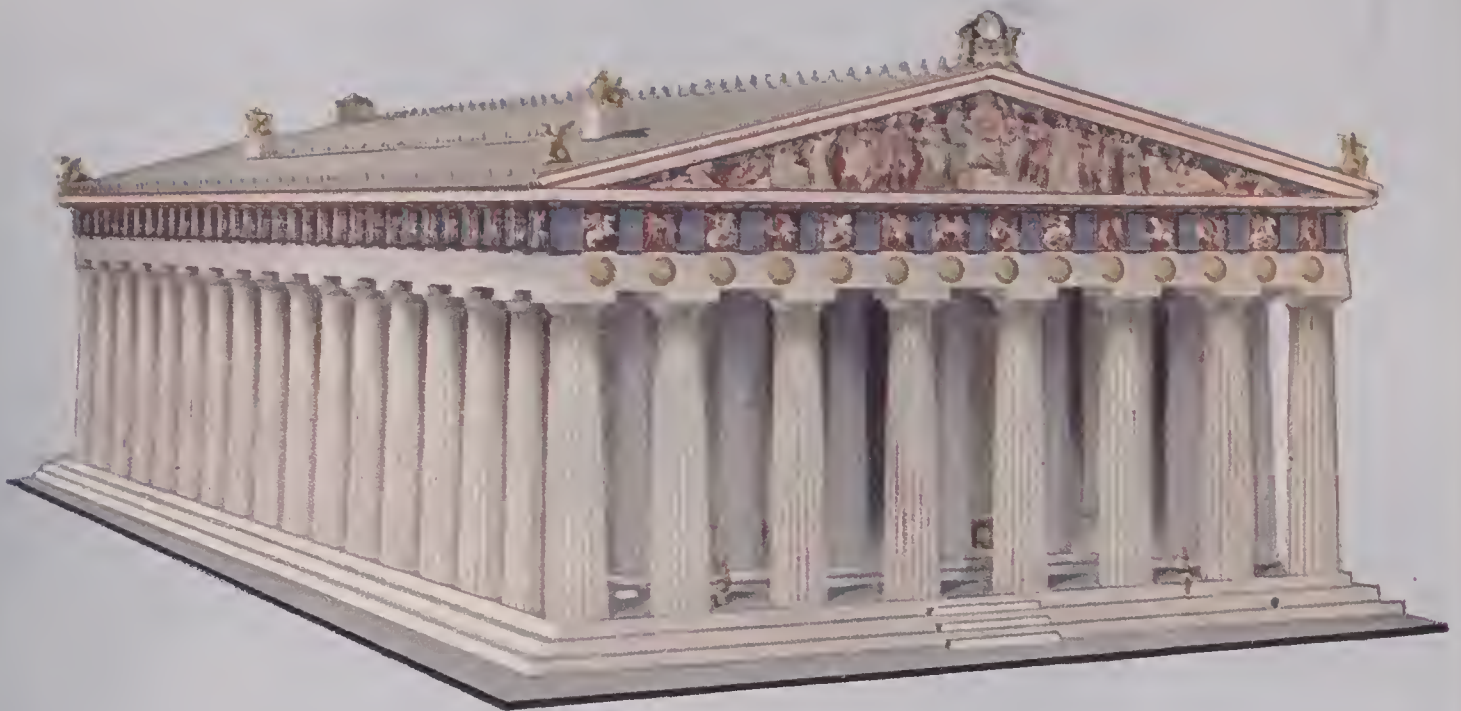
The Persians, who conquered Assyria and Babylonia and later invaded Egypt, combined the arts of all three countries in huge palaces of brick and stone, using the round columns as well as the square towers, and adding elaborate decorations of their own.

But the architecture of these Asiatic nations, like that of Egypt, rested on a basis of tyranny and slavery. The freedom of their art was choked as was the freedom of their people, and the chief aim was to make buildings bigger and bigger, without much improvement of form or addition of real beauty.

Greek Architecture and Greek Culture

During these same early centuries, however, a far greater and more fruitful art was being developed on the coasts and islands of the Aegean Sea, and reached its height on the island of Crete. Nearly 2,000 years before the Christian era the Cretan builder had already learned the most difficult lesson of architecture. He knew how to *plan* a structure so it would "come out right." The ruins of the great palace at Cnossus show with what skill the architects of Crete could bring together, in beautiful and regular arrangement under one roof, many rooms, halls, and passageways. Egyptian architecture reached its highest expression in tombs and monuments to the

CROWNING GLORIES OF ANCIENT ARCHITECTURE



Here are models of two of the most famous buildings ever constructed—at the top of the Parthenon at Athens, and below a part of the great Hall of Columns in the Temple of Karnak, Egypt. They are in ruins today, but these reconstructions show them as they looked when first built. The Parthenon or Temple of Athena was planned by the architect Ictinus and completed in 438 B.C. It stood on the height of the Acropolis, where the exquisite proportion of its lines were the pride of every Athenian. Note that its famous sculptures, by the artist Phidias, were painted in life-like colors. The Hall of Columns at Karnak was completed in the 14th century B.C. by the great monarch Rameses II. Four more rows of small columns flanked each side of the portion shown here, making 134 columns in all. The size of these may be grasped by a comparison with the tiny figure of a man shown standing beneath the great roof.

gods; Cretan architecture, on the other hand, was alive to the needs and comforts of living men.

Out of this earliest European civilization grew the culture of Greece—the greatest of its kind the world has ever known. The story of Greek art in its many phases is told in other articles in this work. Here we shall consider only how the spirit of the Greek people is reflected in that architecture, which is so clear in its simple beauty that it remains the wonder and delight of men to this day.

The Greeks were above all straight thinkers. When they put up a building, they wanted it to be reasonable. If a pillar had to support a heavy weight, that pillar must be strong and look strong; if it bore only a light weight, it must be light and look light. They hated tricks of decoration and the sham of idle stonework. Every portion of the building had to do its share toward expressing the purpose of the whole structure. The columns were never mere ornaments; they always held something up.

The Greeks disliked curved lines, for these seemed to lack straightforward strength. So they would have nothing to do with the arch. Their doors, windows, and roofs were constructed entirely on the *post and lintel* plan—two straight piers or columns with a single straight stone across the top.

Working with only columns and straight lines, the Greek architects created their beautiful effects by the exquisite balance and proportion of their work. Look at the picture of the matchless Parthenon, as it stood on the Acropolis at Athens in the 5th century B.C. Can you take anything away or add anything to it, without marring its beauty? Make it taller and it becomes top-heavy; make it broader and it is squatty. That world-famed temple sums up the free genius of a free people, who could not be imposed upon by mere size and weight, but who loved true and natural beauty for its own sake.

The graceful language of the Greeks, the flow of their poetry, the eloquence of their orators, the just discipline of their law, the keen edge of their philosophy, the refinement of their tastes, even the simple dignity of their draped costumes, are all reflected in the spirit of their unrivaled architecture.

The three styles of Greek architecture are generally distinguished as *Doric*, *Ionic*, and *Corinthian*. These can be recognized most readily by the design of the *capital* or top of the column, and by the *entablature*, which is the name given to that part of the building directly above the column. The Doric was the simplest of the three and is found in the buildings of the most artistic period. The Ionic, with its ram's horn

curls, retains much of the Doric simplicity; but the elaborate scroll and carving of the Corinthian, with its capital modeled on the acanthus plant, marks the beginning of the decay of Greek art under the influence of the Orient.

Architecture and Engineering among the Romans

The Romans borrowed the forms of Greek architecture without fully grasping the Greek spirit. The result was not always beautiful. For instance, they often put columns on their buildings and monuments without giving them anything to hold up.

Also, they never learned the Greek sense of delicate proportion, and their work at times became clumsy and heavy.

On the other hand the Romans were far greater engineers than the Greeks. They built with a more practical eye, and as their vast empire increased in size their architecture developed to meet its needs. They took the despised arch and made it the most useful of all building devices. While they were borrowing their ornaments from Greece, they were inventing

many structural forms all their own.

With the arch the Roman engineers bridged wide valleys and built aqueducts to bring water from distant hills to Rome. They constructed sewers and monuments, tombs and temples, culverts and circuses, all on the same principle. They discovered that when two arched tunnels cross each other, a square vault is formed with ridges running to the four corners. Because of these ridges such a vault is called a *groined vault*. By gradually increasing the size of this vaulting they were able to roof over large square rooms without breaking up the floor space with columns or other supports.

Then, by applying their knowledge of the arch principle to the *dome*, they were able to develop this form of roof, which had been used on a small scale in eastern countries, into a covering for huge circular compartments.

The Pantheon in Rome is an excellent example of the mixture of Greek ornament and Roman engineering construction. The front or *portico* is modeled after the Greek temples, but behind rises the typical Roman dome. While the exterior of this dome is in no way beautiful, the interior which it covers is impressive in its magnificent size and because of its lighting, which is accomplished by a great circular opening at the crown.

The use of the arch and dome prevented the Romans from cultivating lightness of style. The structure of any arch formation is such that it develops side *thrusts*—that is, it tends to push outward the walls or columns supporting it (*see Arch*). To overcome

"During the first six thousand years of the world, from the immemorial pagoda of Hindustan to the cathedral of Cologne, architecture was the great handwriting of the human race. Not only every religious symbol, but every human thought, has its page and its monument in that immense book. The human race has had no important idea which it has not written in stone. Humanity has two books, two registers, two testaments: masonry and printing—the Bible of Stone and the Bible of Paper."

—Victor Hugo.

HOW HISTORY IS WRITTEN IN LETTERS OF STONE — FROM THE PYRAMIDS



The story of great buildings begins with these Egyptian slaves, nearly 5,000 years ago, pulling and prying along the huge blocks of stone out of which the pyramid in the background is being built. It is brutal work, and we may imagine that these men have been toiling in the burning African sun for many years upon this half-finished mass of masonry. Next we see the descendants of these same slaves working on the great Karnak



Temple, 1,500 years later. The building art has improved, and wheeled carts are used to haul the stone. But think of carving out and erecting by hand these immense round pillars! It's still the work of slaves. In the next step all this is changed. We cross the Mediterranean from Egypt to Greece and find the free



Athenian citizens of the 5th century B.C. busy on a corner of the famous Parthenon. Here civic pride and love of beauty inspire the work. Next we find a colonnade going up on the Campus Martius in the days of Imperial Rome. These men were great engineers, who borrowed ideas from the Greeks, adding great skill in the construction of the arch. When the Roman court moved to Constanti-

these thrusts, the Romans built their walls thick and with few openings.

But much of this heaviness may be traced to the same cause as the heaviness of Egypt. True freedom had ceased to exist at the time of Rome's greatest building enterprises. The builders were often political leaders seeking personal glory. With slave labor and abundance of materials bought with the wealth of conquered peoples, the rulers of Rome could give free rein to their extravagance. The ultimate result was the massive but rather tasteless splendor of triumphal arches, and of such gigantic structures as the Colosseum, in which Greek refinement was wholly lost.

Art of the Byzantine Empire

When the emperor Constantine made Byzantium the new capital of the Roman Empire and gave it the name Constantinople, the way was prepared for a new and vigorous style of architecture. Grecian culture and reason, Roman power, and the Oriental love of gorgeous decoration joined hands to give the world Byzantine art. The Greeks had devoted their best efforts to make the *exterior* of their buildings pleasing to the eye. The Byzantine builders, on the other hand, turned their attention almost entirely to the *interior*.

They used the dome as the main element of their greatest structures. A glance at the illustration showing the interior of the famous church of Santa Sophia—the "Holy Wisdom" of God—shows how

they obtained their effects of vastness and grandeur.

The tremendous central dome rests upon half-domes at each end, which in turn are supported by still smaller half-domes—creating a huge enclosure, with an unequaled sweep of open floor-space.

The Romans had never learned how to construct a dome except over a circular compartment. The Byzantine architects invented a way of putting a dome over a *square* room. This was done by filling up the corners with a mass of masonry, which continued the curve of the dome until it tapered off to a point at the lower end. This device is called a *pendentive*.

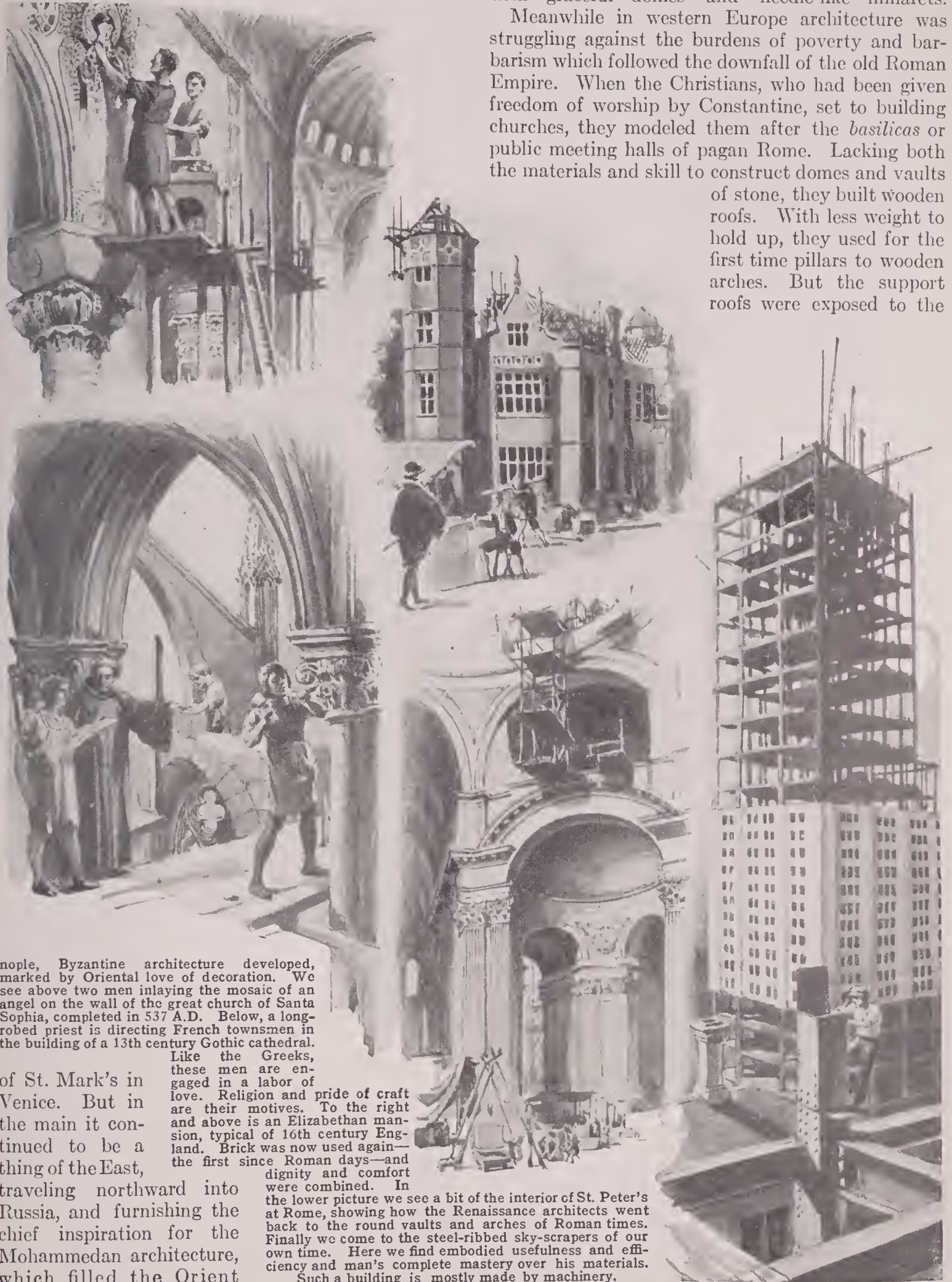
The Byzantine dome system shows careful engineering. The successive curves not only hold up the immense weight above them, but resist successfully the enormous outward *thrust*, always found, as we have seen, wherever the arch principle is used. But in spite of this clever planning, the walls had to be made very thick. That is why Santa Sophia from the outside looks squatty, like a crowded cluster of huge mushrooms.

Byzantine architecture was later copied to some extent in Italy, notably in the great domed cathedral

OF EGYPT TO THE SKY-SCRAPER

with graceful domes and needle-like minarets.

Meanwhile in western Europe architecture was struggling against the burdens of poverty and barbarism which followed the downfall of the old Roman Empire. When the Christians, who had been given freedom of worship by Constantine, set to building churches, they modeled them after the *basilicas* or public meeting halls of pagan Rome. Lacking both the materials and skill to construct domes and vaults of stone, they built wooden roofs. With less weight to hold up, they used for the first time pillars to wooden arches. But the support roofs were exposed to the



nople, Byzantine architecture developed, marked by Oriental love of decoration. We see above two men inlaying the mosaic of an angel on the wall of the great church of Santa Sophia, completed in 537 A.D. Below, a long-robed priest is directing French townsmen in the building of a 13th century Gothic cathedral.

of St. Mark's in Venice. But in the main it continued to be a thing of the East, traveling northward into Russia, and furnishing the chief inspiration for the Mohammedan architecture, which filled the Orient

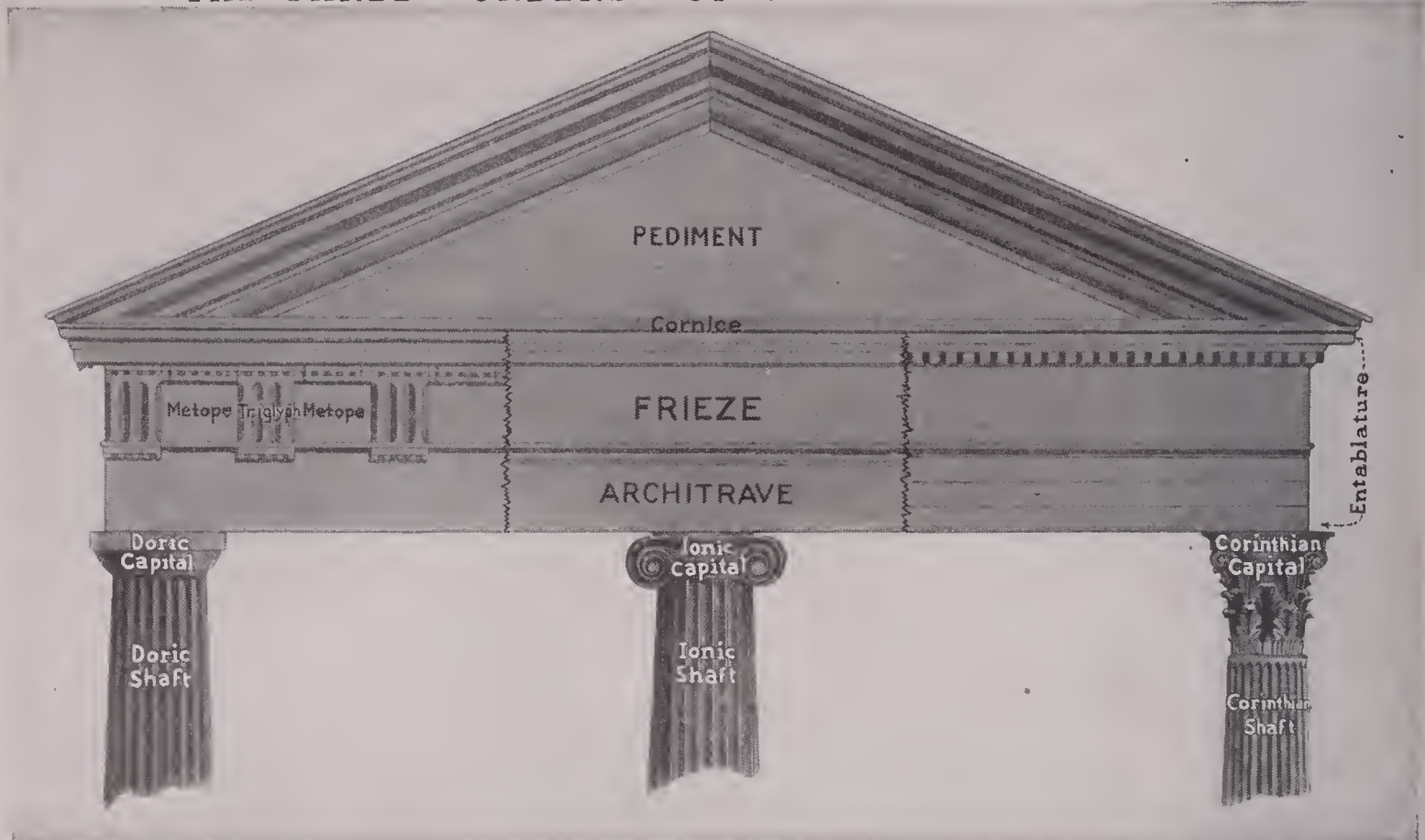
Like the Greeks, these men are engaged in a labor of love. Religion and pride of craft are their motives. To the right and above is an Elizabethan mansion, typical of 16th century England. Brick was now used again—the first since Roman days—and dignity and comfort were combined. In

the lower picture we see a bit of the interior of St. Peter's at Rome, showing how the Renaissance architects went back to the round vaults and arches of Roman times. Finally we come to the steel-ribbed sky-scrapers of our own time. Here we find embodied usefulness and efficiency and man's complete mastery over his materials.

Such a building is mostly made by machinery.

contained in the Easy Reference Fact-Index at the end of this work

THE THREE "ORDERS" OF GREEK ARCHITECTURE



There's a legend that the early Greek architects, discovering that the height of the average man is about six times the length of his foot, always made their columns (including the capitals) six times as tall as they were broad at the base. This is one of the things which accounts for the pleasing proportions of Greek temples. Whether or not this story is true, the Greeks did have many definite rules for building beautifully. In this picture we see the several parts of a typical temple gable, including the three types of columns with the entablatures above each. It shows how Greek "styles" began with simple Doric dignity, then changed to the "ram's horn" Ionic style, and finally lost their vigor in the acanthus leaf ornaments of the Corinthian. The pediments of the temples were usually filled with sculptured figures, and the same was true of the "metopes" between the "triglyphs"—the latter representing in stone the ends of the wooden beams in the earlier temples.

peril of fire. In fact nearly all the buildings of this period were destroyed by fire.

No great improvements were made, however, until after Charlemagne had succeeded in reviving in western Europe the memories of Rome's ancient greatness, and had kindled the hope that Christendom might be united forever in a Holy Roman Empire. This brought a revival of architecture based on Roman forms, out of which was born a new style called *Romanesque*. The outstanding feature of this style was the development of the old *groined vault* of the Romans. Having no concrete, with which the Romans reinforced their work, and being forced to economize weight and building materials, architects now had to find a simple method for strengthening these vaults. They hit upon a great idea. They developed the groins or ridges at the four angles into independent ribs of stone, which met in the center of the vault. Resting upon the corner supports of the vault, the ribs simply took the form of two diagonal arches, crossing each other in the middle like the ribs of an open umbrella. Upon them the roof of the vault, made now of light stone, was laid. The four side arches leading into the vault also became independent stone ribs, supporting the sides of the roof.

Since each of these rib arches was a perfect half-circle, those spanning the vault diagonally were naturally higher than those spanning the sides. When

the roof was laid, therefore, it had to be domed up from the side arches over the taller center arches.

This invention of a framework or skeleton of stone ribs was the great contribution to architecture made by the Romanesque builders. Having learned from the early Christian basilicas that round columns could be trusted to support arches, they used them to hold up the new style of vault. In this way they could put many equal-sized vaults end to end, roofing over a long enclosure. This enclosure would then be flanked on each side by a *colonnade* or row of columns.

This, indeed, was the way they built their churches. The *nave* or central part of the church between the colonnades was a high clear space from the entrance at one end to the altar at the other. The altar usually stood in a semicircular projection, covered with a half-dome, which was called the *apse* and which closed that end of the structure, supporting the outward thrust of the last vault.

To the right and left of the nave were the side *aisles*, covered by a lower roof composed of smaller vaults. The outer arches of these smaller vaults were filled, forming the exterior walls of the church. Small arched windows pierced these walls and lighted the aisles. Sometimes the aisle space was divided into two stories, each of which looked out upon the nave through rows of smaller columns and arches built between the big main columns. In front of the altar

THE TEMPLE OF ALL THE GODS AT ROME



This model shows how the famous Pantheon looked in the days of imperial Rome. Erected by Emperor Hadrian in 123 A.D., it remains today much as you see it here. The Romans admired Greek architecture, so the portico or entrance was built in Corinthian style. But for the main building the architects constructed massive circular walls crowned with a great dome, thus inclosing a round hall 142 feet high and 142 feet in diameter, lighted by a 27-foot opening pierced in the summit. Such a wide spread of clear floor space would have been impossible with the Greek system of straight stone beams supported on columns. On the other hand, the builders of the Parthenon at Athens would have been horrified at this combination of two utterly different styles of architecture. In the left-hand corner are sketches of the arch and dome—the two principal devices introduced by Roman builders.

and cutting the aisles and nave at right angles there was usually a more open space like the arms of a cross. This was called the *transept*.

Usually the nave rose to a considerable height above the roofing of the aisles, leaving a clear wall space through which windows were cut, admitting light directly into the upper part of the nave itself. This device known as the *clerestory* was first used by the Egyptians in their temples.

The Romanesque movement started in Italy and spread rapidly. The peoples of western Europe were awaking from their long sleep and were shaking off the dead weight of barbarism. Europe, wrote a monk of the 11th century, was "adorning itself with a

white garment of churches." For the most part the monks were the builders, though many a great "cathedral," or bishop's church, arose at this time.

Yet the Romanesque, solid and skilful though it was, did not satisfy the soaring spirit of the Middle Ages. Those churches were heavy and dark, for the

architects feared the thrusts of the great vaults, and they strengthened their thick walls with massive *buttresses*, keeping their window spaces small. It was a style well fitted to the castles of warring nobles, but unsatisfactory for religious buildings in cold climates, where all the sunlight possible was needed.

Then, suddenly, there was born in northern France

a new architecture and a new art, which seemed to grasp its inspiration out of the very air men were breathing. It was the style we call "Gothic." To understand this architecture, considered by many the greatest of all building achievements, we must remember the great changes that swept over Europe and particularly over France



Here, in the Colosseum built by Vespasian in the 1st century A.D., we see how far the Romans carried the use of the arch. This immense amphitheater, 616 feet long and 510 feet wide, seated more than 50,000 spectators. In its arena the most famous gladiators fought and countless Christian martyrs were thrown to wild beasts.

during the 12th and 13th centuries.

The religious fire fanned by the monks had set on foot those most romantic of all enterprises—the Crusades. While knights and princes were fighting for Christianity in the East, a new feeling of independence and power was born among the townsmen

THE "JEWEL BOX" OF CONSTANTINOPLE



The squatty massive exterior of Santa Sophia in Constantinople conceals one of the most gorgeously beautiful interiors in the world. Built by the emperor Justinian in the 6th century, this famous church became a Mohammedan mosque, when the Turks captured the city in 1453. The surrounding towers or "minarets" were erected by the Turks. The drawing in the upper right-hand corner shows part of the roof cut away, to let us see how the Byzantine architects supported the great dome upon a descending series of half domes, and so created the enormous sweep of clear floor space shown on the opposite page.

at home. When the crusaders returned, the old tyranny of the feudal lords began to crumble and the authority of the kings gained strength. In the fight against the nobles the kings bargained for the support of the towns by granting the citizens new liberties and privileges. With the new freedom came intense city pride, fostered by the guilds of skilled workmen, who were the leaders of the townsmen.

In a later day men burning with such political and religious zeal might have written great poems or painted great pictures. But now they turned their energies to building cathedrals, as the churches of bishops were called, and each city sought to outdo its neighbors.

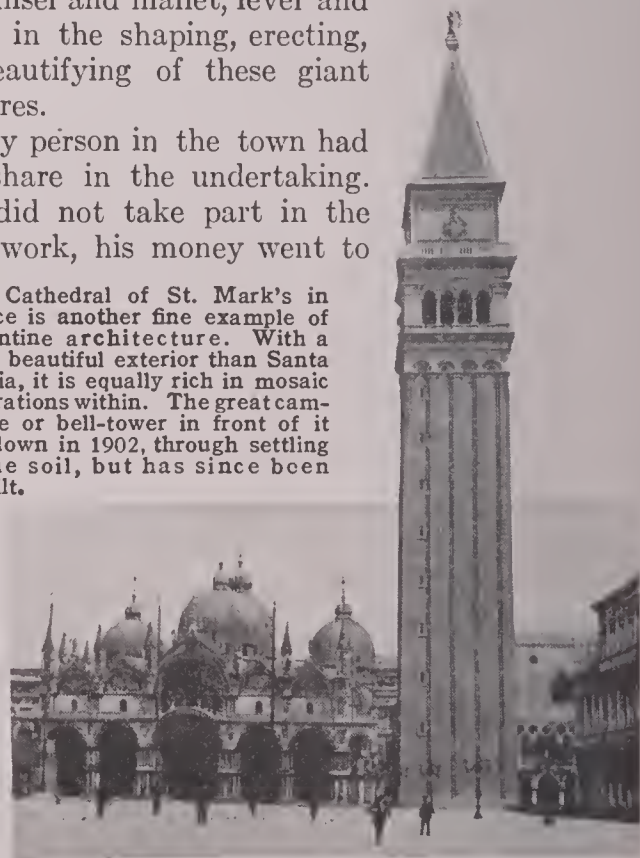
Rich and poor, old and young, delighted to take part in the pious work of helping to build a great church which should be worthy of their beloved town. For miles the roads would be thronged with processions of men and women—some of them even princes and great nobles—tugging at long ropes which dragged slow-moving carts loaded with building materials and food and drink for the workmen. Black-robed priests might be seen here and there exhorting them to greater zeal, for the building of a cathedral was the work which taxed the piety and resources of several generations.

Even more animated was the scene at the chosen spot where the soaring arches of the cathedral slowly

rose from their cradle of scaffolding. Under the keen eyes of the bishop and the master architect, a host of workmen, proud to have a part in so glorious a work, plied chisel and mallet, lever and trowel, in the shaping, erecting, and beautifying of these giant structures.

Every person in the town had some share in the undertaking. If he did not take part in the actual work, his money went to

The Cathedral of St. Mark's in Venice is another fine example of Byzantine architecture. With a more beautiful exterior than Santa Sophia, it is equally rich in mosaic decorations within. The great campanile or bell-tower in front of it fell down in 1902, through settling of the soil, but has since been rebuilt.



THE INTERIOR OF SANTA SOPHIA



Columns of green and red marble, the glistening splendor of gold and mosaic decorations, and the play of lights and shadows on the walls make the interior of Santa Sophia a sight never to be forgotten. Above all is the impressive sweep of curve upon curve, rising upward 175 feet to the apex of the giant dome. The mosaics which represented human figures have been covered over with stucco by the Mohammedans, for their religion forbids images of living creatures; the walls have also been hung with great round shields bearing quotations from the Koran in Turkish script. The floors are covered with prayer mats, on which the worshipers kneel facing toward Mecca.

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SPLENDID INTERIOR OF PISA CATHEDRAL



This view of the interior of the cathedral at Pisa, Italy, begun in 1063, shows a high development of the Romanesque style. This form of architecture began with an imitation of the old Roman basilicas, and was at first exceedingly bare and somber. By the 11th century, however, the Romanesque architects of Italy had felt strongly the influence of the Byzantine love of decoration. Among the characteristics of this style of building was the increased use of long rows of pillars to support heavy arches. The walls were thick with small window and door openings, and the roofs were comparatively low, for the builders had not learned to trust their buttresses, nor had they developed the wonderful system of ribbed vaulting which made possible such great Gothic structures as that shown on the next page.

swell the building fund, in the form of regular offerings or special contributions. The rest of the expense was met from the revenues of the bishop and the cathedral clergy.

In scores of towns of France and Germany such scenes were enacted, as one glorious Gothic cathedral after another sprang into being. In these structures we see enshrined the very soul of the Middle Ages, "a prayer materialized and apparently imperishable." No better parallel for this joyous spirit of creation can be found than by comparing it to the spirit of national joy and civic pride that gave birth to the noble buildings of Athens under Pericles. The Scottish essayist Carlyle once asked for "men who sing at their work." If we bear in mind that the workmen of the Gothic churches sang and worked with an intense spiritual fervor, we shall understand the blithe religious spirit in which these beautiful fabrics were raised.

By looking at such superb achievements of the new art as the cathedrals of Amiens and Notre Dame of

Paris you can pick out the most important points in which they differ from the Romanesque structures. You notice the increased height of the interior, the lightness and delicacy of the clustered pillars, and you observe that the pointed arch has taken the place of the round arch and become the *motif* carried throughout the amazingly elaborate scheme of decoration. And you notice too—for this is a key to the whole new style—the great lofty window spaces filled with glowing colored glass. Finally you gaze at the bewildering exterior, with its system of slender arched props springing from the tops of the solid buttresses, and curving like long thin fingers to the clerestory walls, where they resist the enormous outward pressure of the vaulted stone roof. These are the famous *flying buttresses*, without which the structural miracle of the Gothic cathedral would be impossible.

The new builders had, above all, two objects. First, they were trying to increase the size, majesty, loftiness, and dignity of their sacred buildings that they

NOTRE DAME, THE QUEEN OF FRENCH CATHEDRALS



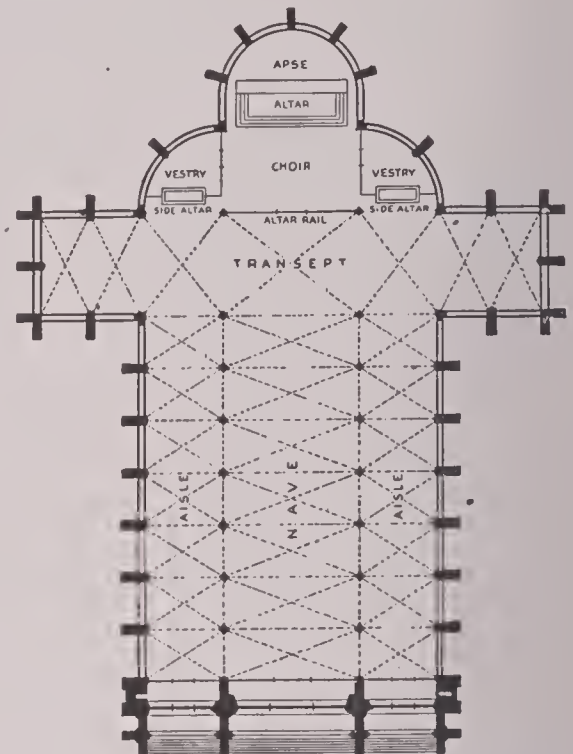
For eight centuries this great church has stood on the narrow islet in the Seine River which forms the center of Paris, and has seen the tides of history sweep by. The good king, Saint Louis IX, passed through those massive doors to pray before he started away on his ill-fated crusades. The Paris mob during the French Revolution stormed these portals, tearing down the statues of saints and kings and setting their "Goddess of Reason" upon the altar within. Victor Hugo wove about these walls, stained with age, his most famous romance, 'Notre Dame de Paris'. The foundation stone of the cathedral was laid in 1163 by Pope Alexander III, at that time a fugitive from Rome, and the main edifice was completed about 1240. It was one of the earliest of Gothic churches, retaining some of the massive qualities of Romanesque architecture. It is 430 feet long and 170 feet wide. Its towers, which rise 223 feet above the street, are adorned with numerous "gargoyles" or grotesque figures of animals and demons.

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might more fittingly express the riches, the power, and the glory of the medieval church, then at the height of its greatness. Second, they wanted to increase the size of the window openings, to admit warmth and sunlight to the unlighted and unheated interiors during the chill of northern winters.

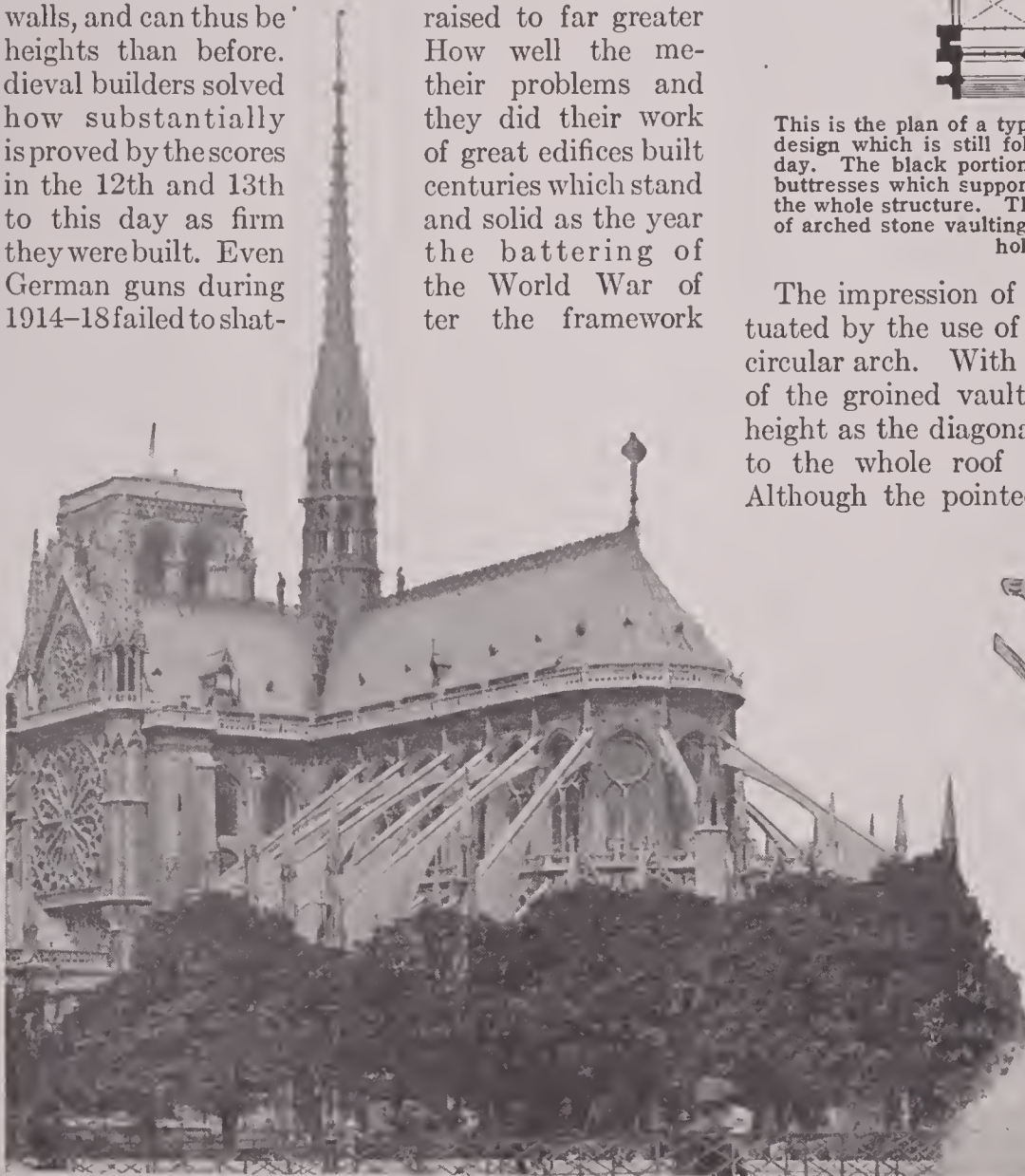
These results were obtained by tremendous feats of bold engineering. The architects gathered the entire weight of the great vaulted roof on a network of ribs springing from piers of clustered columns. Thus the burden of the roof was entirely removed from the walls, and the builders were free to fill in the spaces between the columns with enormous window openings. The side thrusts are carried by deep but narrow buttresses braced against the exterior walls, and by that wonder of engineering, the flying buttresses. Thus the principle of the skeleton framework has been extended to the whole building, just as in the steel skeletons of the sky-scrapers of today. The whole great structure of ribs and buttresses, supporting the vaulted roof, is strong enough to stand alone without any supporting walls, and can thus be raised to far greater heights than before. How well the medieval builders solved their problems and they did their work of great edifices built centuries which stand and solid as the year the battering of the World War of 1914-18 failed to shatter the framework

of the great cathedral of Reims, though they destroyed much of the exquisite decoration that had made it one of the glories of France.

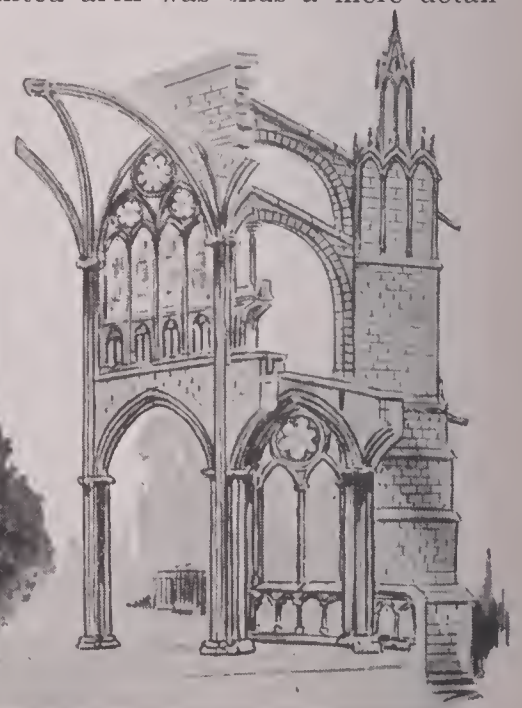


This is the plan of a typical medieval church—a cross-shaped design which is still followed in many churches of our own day. The black portions show the position of the piers and buttresses which support the weight and bear the stresses of the whole structure. The dotted lines indicate the framework of arched stone vaulting, connecting buttresses and piers and holding up the roof.

The impression of lightness and delicacy is accentuated by the use of the pointed arch instead of the circular arch. With the pointed arch the side arches of the groined vaulting can be raised to the same height as the diagonal spans, giving greater strength to the whole roof and exerting less side thrust. Although the pointed arch was thus a mere detail



This rear view of the Cathedral of Notre Dame shows us how those long slender "fingers of stone"—the flying buttresses—project over the low-roofed aisles to brace the soaring walls against the outward thrust of the arched vaulting. Delicate as they look, they have stood firm for 800 years—a proof of the wonderful engineering skill of these old French builders. The sketch at the right shows the system of double flying buttresses thrust out from piers of solid masonry in the famous Amiens cathedral.



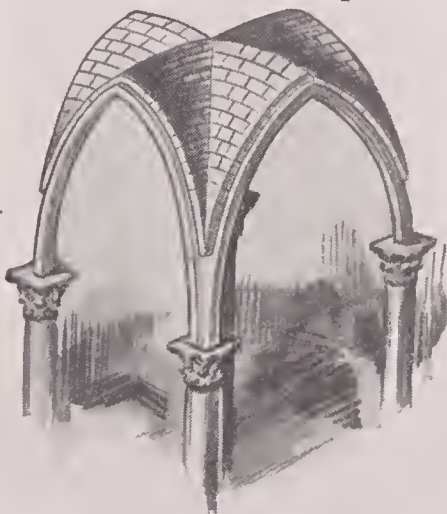
ST. PETER'S AT ROME—THE CHURCH OF CHURCHES



The great Michelangelo built a portion of this church of the popes, partly on his own design and partly following the plans of his great predecessor, Bramante. Both were under the influence of that enthusiastic revival of classical learning and art called the Renaissance. They failed to appreciate the more original and imposing beauty achieved by the Gothic builders, and went back to Greece and ancient Rome for their models. This accounts for Michelangelo's dome, and for the tasteless Greek portico, the latter the work of a later and lesser artist. This dome is the highest dome in the world, measuring 437 feet to the top of the cross on the ball, and is a triumph of architectural beauty. The ball, which looks like a tiny circle from below, is large enough inside to accommodate a dozen people. It is reached after a steep climb between the inner and outer "skins" of the dome. From a glance at St. Peter's, you realize where the architects of the capitol at Washington and of many other great public buildings in America obtained their inspiration. The long severe buildings at the right form a wing of the Vatican—the Pope's residence—and illustrate the style of architecture much used in Renaissance residences.

growing out of the new structural principles, the genius of the medieval builders seized upon its decorative possibilities and made it a keynote repeated and emphasized everywhere—in the window openings, in the niches, and in the slender pinnacles that capped the buttresses and towers.

To provide suitable decoration for such marvels of Gothic architecture, the builders developed ornamentation to a wonderful pitch of richness and ingenuity. The great wallspaces which the Italians had filled with paintings gave way to exquisite creations in the new art of stained glass, bathing the interior in a sea of living colors and telling biblical stories and Christian legends. The art of the sculptor was brought in to adorn the whole fairy-like fabric with a myriad of images of men, animals, and plants, often carved with rare delicacy and fidelity. Here the joy-



This drawing illustrates the principle of the Gothic vault and the "reason" behind the pointed arch. You can see at once that the curve of the diagonal rib, passing through the center of the vault between the pillars at the extreme left and right, is a half circle. The span of the side arches is, of course, narrower than the diagonal span, and half-circle arches in these positions would not reach as high as the middle arches. To bring them up to the latter level they had to be made pointed.

ous fresh-eyed genius of the times found full scope for expression, brimming over into an exuberance of fancy that put hideous grotesques and grinning demons side by side with reverent conceptions of the saints and apostles.

Gothic Architecture in Different Lands

From France the Gothic style spread to Germany, Spain, and England, taking on subtle differences that mirror national character. In England there arose a tendency to emphasize straight lines, especially in the mullions and bars of the enormous windows. This tendency asserted itself in other decorative features, finally resulting in the formation of a definite style known as the *Perpendicular*. At the same time the ribs holding up the vaulting were multiplied and cross ribs were added, dividing the surface into elaborate patterns of exquisite delicacy

and complexity. Instead of this *fan vaulting*, magnificent open timber work, such as that which forms the most striking feature of many of the Oxford and Cambridge colleges, was often used to support the roof.

Church towers and spires, which reached such a high development in Gothic times, date back to a much earlier period. Perhaps the old Babylonian tower temple was the ancestor of the steeple. In Christian countries they were first built separate from the churches, like the *campaniles* or bell towers of Italy. In Romanesque times they had become important parts of the church itself. The skill and artistry required to create towers worthy of the great Gothic cathedrals can be appreciated by a glance at the famous twin spires of Cologne.

The knowledge of engineering acquired in building Romanesque and Gothic churches made possible also those great castles of the Middle Ages, erected by kings and nobles for military purposes. Indeed, the whole story of those stirring days is summed up in a way by those two types of building—the castles of the noble lords and the cathedrals and town- and guild-halls of the townsmen.

But the reign of Gothic art was short. With the Renaissance came a revival of the old Greek and Roman styles. Men became enslaved for a time in the worship of antiquity, declaring that there was no art except the art of Rome and Athens. They even came to look upon these cathedrals as the hideous work of barbarians, and so gave to this art the misleading name—"Gothic"—which it still bears (*see Renaissance*).

In the 15th century under the influence of the revival of classical learning and art, the pointed arch again yielded to the round arch of the Romans. The old classic columns, capitals, and other details were again employed, together with the many forms of ornament of the Graeco-Roman patterns. How

complete was this reversion to classical styles may be seen by the extent to which it survives today in our most familiar examples of architecture and ornament. Renaissance pediments—curved or gable-shaped—like many other Renaissance details are everywhere to be seen, in public buildings and houses, in railway cars, and even in furniture.

Architecture and the Home

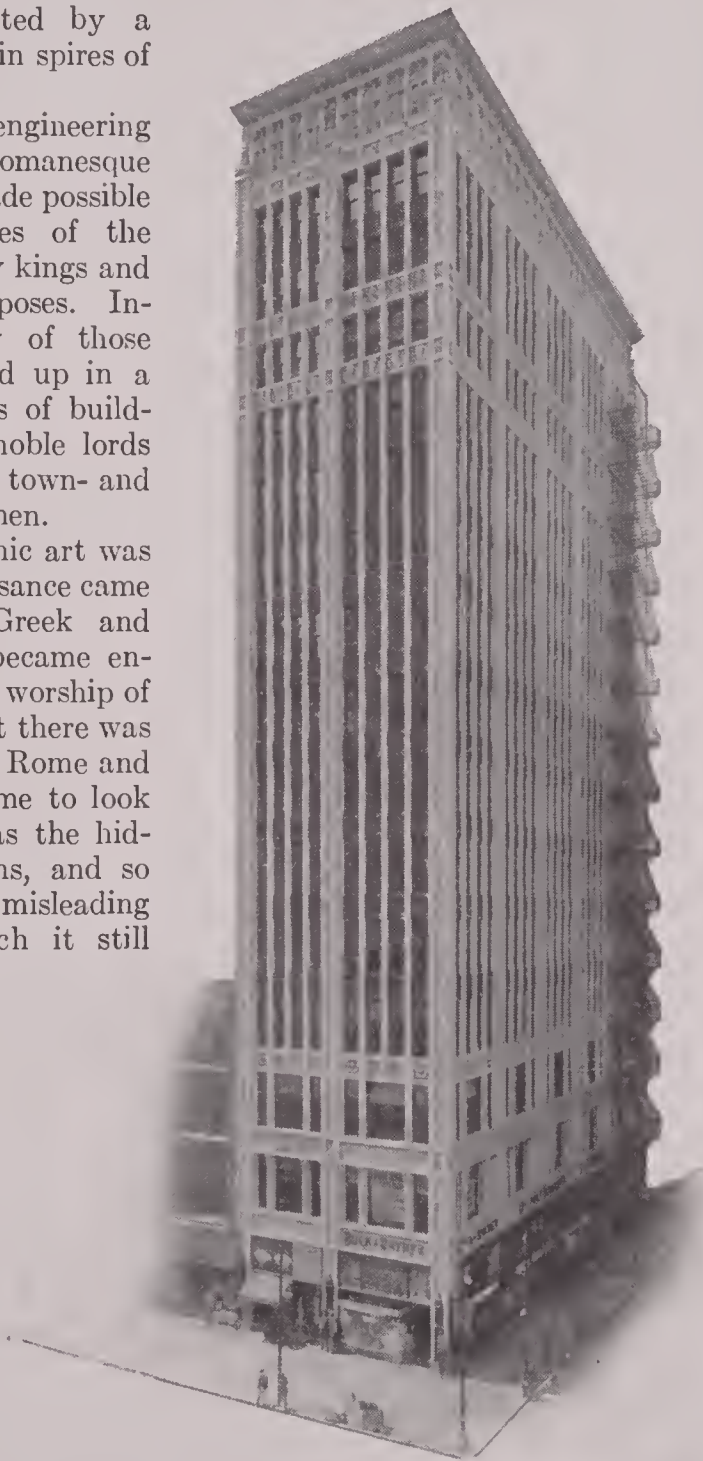
At the same time there came a vast improvement in the comfort of domestic arrangements. With the introduction of window-glass, chimneys, carpets, and comfortable furniture, builders began to construct houses which should no longer be hovels or castles but elaborately decorated and luxurious residences. This taste for domestic comfort gradually found expression in such palatial mansions as the Pitti Palace in Florence, and Hampton Court in England. In the latter country the reign of Queen Elizabeth was marked by the building of scores of noble residences—the Elizabethan manor houses, many of which still stand as among the greatest achievements of English architects. The rediscovery of the art of making bricks, forgotten since the time of the Roman Empire, provided the architects of this period with a convenient and adaptable material.

But it was not long before men's tastes ran to elaborate decorations and florid styles, called *Baroque* and *Rococo*. No great new principles of building were invented, and in many large public buildings the greatest confusion of styles prevailed, with a bewildering and often tasteless intermingling of straight lines and curves, arches and pillars, scroll work and sculpture.

In this confusion architecture as the expression of a national spirit died. Instead grew up scores of schools founded by successful architects, each following its own tastes. While the results were not always happy in the larger public enterprises, there was steady progress in giving to private homes more beauty and comfort.

Leaving Europe, we find

REACHING UP FOR ROOM



A fine example of "sky-scraper" architecture, one of many in the crowded "Loop" district of Chicago. It shows how the tallness of such buildings, which tends to throw them out of proportion, can actually be made impressive and beautiful by the use of long straight piers which give unity to the design and emphasize the simple usefulness of the whole structure.

vigorous styles developing in the New World. Spanish monks in Mexico and California produced buildings well suited to the climate and with the distinctive lines we recognize today under the name of *Mission* architecture. In some instances they imitated successfully the building methods of the ancient Aztec Indians.

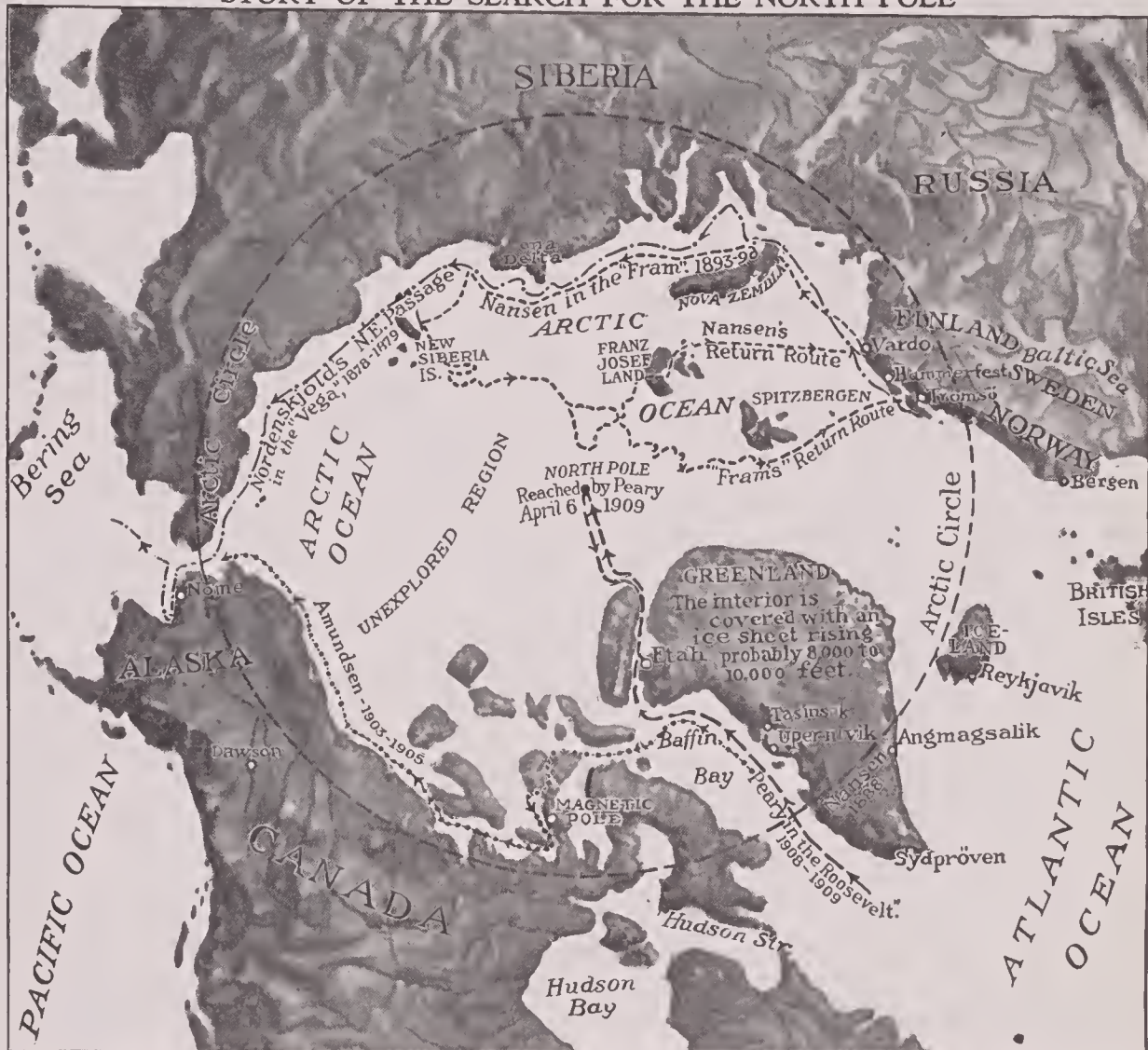
In the English colonies in America a type called *Colonial* grew up, marked by the dignified use of pillars and portico, and by a return to classical principles of line and proportion.

But it was not until steel construction began that any vitally new architecture arose. This style, which is typically American, finds its highest expression in the modern sky-scraper. Crowded together as these immense buildings are in our cities, it is difficult to appreciate their full and vigorous beauty, especially when the simple lines are handled by a master architect. The straight sweep of stone piers, rising

square miles, half as large as all of North and South America—consists of the Arctic Ocean and the many islands and archipelagoes which it contains.

Aside from these continental fringes, the greatest land mass of this region is Greenland, which lies

STORY OF THE SEARCH FOR THE NORTH POLE



Here is a map-story of the Pole that Peary found, and also of the various attempts of other bold explorers to attain this icy prize. Do you notice that the Magnetic Pole and the North Pole are two entirely different things and situated a long distance apart? If you long to be an explorer, notice also that there is still a vast region north of Canada that man has not yet traversed.

aloft between the rows of windows, carries with it an inspiration which surely would have delighted the imagination of those Gothic masters, who believed above all in the fitness of the means to the end. (See Building Construction.)

ARCTIC REGIONS. Imagine a gigantic pair of compasses with one leg set at the North Pole and the other about 1,750 miles to the south at latitude $66^{\circ} 32'$ N. The circle of more than 10,000 miles which the lower leg would mark on the earth is the Arctic Circle, and the area included in its sweep is known as the Arctic regions.

For about four-fifths of its circuit the Arctic Circle passes over land, cutting off from Europe, Asia, and America fringes averaging about 300 miles wide in North America, and reaching a width of nearly 600 miles in parts of Siberia. The remainder of the Arctic regions—a vast tract of more than 8,000,000

almost wholly within the Arctic Circle. It is a vast island belonging to Denmark, about seven-eighths as large as the original 13 states of the American Union. Here too is the great Arctic archipelago of America—Baffin Land, Banks Land, Victoria Land, Grant Land, and the many other frozen wastes that have lured so many brave men to their doom. Among other islands and archipelagoes are Spitzbergen, Nova Zembla, and Franz Josef Land, lying north of Europe, and Nicholas II Land and New Siberia, lying north of Asia. These desolate regions are for the most part uninhabited, and visited only in the summer time by hunters, fishermen, and ivory-miners. In many places there are enormous deposits of fossil ivory—the tusks of the mammoths that used to roam this region in the long ago, when it had a milder climate.

Not until recently has there been a systematic attempt to develop the mineral wealth which is

known to exist in Nova Zembla, in Spitzbergen, in Northern Alaska, and elsewhere. Now rich deposits of coal have been found and mining has begun in Arctic Alaska, and American, British, and Swedish companies are shipping coal in considerable quantities from Spitzbergen. But attempts to develop the industrial resources of the Arctic lands are made under enormous difficulties. Throughout the whole of the Arctic regions the average temperature is below freezing, and the winter temperatures in certain parts average 35 degrees below zero.

Man has a hard struggle to support himself in this inhospitable clime. The Eskimos of America and Greenland, the Indians of Alaska, the Laplanders, and the natives of northern Siberia battle continuously against famine and death. Only about 2,000 species of plant life have been discovered in the Arctic

zone, very few of them trees. Willows, junipers, and birches, stunted more by the dry winter winds than by the cold, are found on the fringes of the region. Flowering plants, ferns, mosses, and lichens have been seen in the northernmost lands visited by man.

Fur-bearing animals are numerous, such as the hare, fox, wolf, polar bear, and musk-ox. They are either permanently white, like the polar bear, or grow white coats in winter, and so their furs are highly prized. The birds are largely sea-birds—gulls, ducks, and geese, together with ptarmigans and snow-birds—and migrate south for the winter.

The sea life is abundant. Whales, seals, and walrus are still found in large numbers, though sadly diminished by ruthless hunting. Valuable fisheries are found on the northern coasts of Russia and other Arctic lands. (See Polar Exploration.)

The AMAZING GROWTH of ARGENTINA

ARGENTINA (är-gén-tē'-na). For nearly three centuries the Spanish adventurers and settlers held the flat monotonous plains of Argentina in little esteem. This southeastern part of the South American continent lacked the rugged picturesque scenery of the Andes regions with their stores of precious metals, as well as the vast and mysterious forests of the Amazon. Yet here, if the Spaniards had only known it, was the true El Dorado—not an El Dorado of gold, but of rich pastures and fields which hold the promise of more wealth than all the gold mines of the earth. In the last half century enormous fortunes have been made on these dusty uninviting prairies, and the Argentine Republic today is the leading country of South America.

One-sixth of the whole extent of Argentina consists of these immensely fertile prairies or pampas which occupy the center of the country, stretching from the Atlantic seaboard to the foothills of the Andes. To the north lies the *Gran Chaco*, a great low plain,

Extent.—North and south, about 2,300 miles; east and west, about 1,330 miles. Area, 1,153,119 square miles. Population, about 9,000,000.

Chief Rivers.—Rio de la Plata and its tributaries, the Parana and the Uruguay; Colorado; Negro.

Largest Cities.—Buenos Aires (capital, 1,640,000 population); Rosario (225,000); Cordoba (156,000); La Plata, Tucuman, Santa Fé, Mendoza (over 50,000).

Chief Products.—Meats, wool, hides, and other live-stock products; wheat, flour, corn, oats, flaxseed, alfalfa; butter and cheese; quebracho and other forest products.

largely unexplored, of desert, forest, lakes, and swamps, inhabited only by fierce native tribes. As the continent narrows to the south the pampas pass into the cold desolate steppe of Patagonia, separated from the more northerly regions by the Rio Negro. This little-known and undeveloped territory, the "Scotland of South America," covers nearly one-third

of Argentina's area. Grasslands are found near the coast, and cattle ranchers are there beginning to supersede the wandering bands of Patagonian Indians (see Patagonia).

The crest of the Andes forms the boundary line between Argentina and Chile. High table-lands and precipitous valleys, most of them too cold and arid for cultivation, but containing mineral deposits which have been little developed, here descend

into foothills which gradually merge into the plains.

Variations of climate are striking, both from north to south and from east to west. In the torrid north, the climate is typically tropical, with abundant

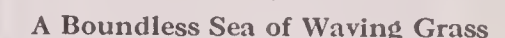
A SCHOOLROOM IN ARGENTINA



Some of the new schoolrooms of Argentina are very attractive. Here is a schoolroom in what was originally a public building for the offices of the government. In the schools of Argentina light and air are given first consideration. The room shown in the picture illustrates this fact. Doesn't it look spacious and attractive? The floors are tiled.

counteracts the influence of the Antarctic waters and the cold winds of the Andes to make the region hab-

itable. Much of western Argentina is arid because the winds from the Andes lose their moisture before reaching the plains. In some regions days of scorching heat under cloudless skies are followed by nights of bitter cold. Most of the country, however, enjoys a temperate climate much like that of the United States and Canada, except that the seasons are reversed.



Life on the great pampas, whence Argentina draws her wealth, somewhat resembles the life of the western plains of the United States half a century ago. Once a vast inland sea, with only a few of the highest points here and there emerging as islands, the pampas today still resemble a sea—but a boundless sea of waving grass at times so high as to hide a man on horseback. The soil is almost invariably fertile where nature or irrigation provides sufficient moisture. Only along the banks of the few feeble streams are there native trees, but settlers have begun to plant the eucalyptus and fruit orchards. Roads are mere tracks of dust or mud according to the season, for there is little stone or gravel for road-making.

This great prairie is divided into enormous cattle and grain ranches, some containing a hundred square miles of land, and the average being about six square miles. A comparatively few wealthy owners were allowed by the government to take up those great tracts, thus bringing about conditions the reverse of those in North America, where the land is in the hands of many settlers. Argentina may be said to be still in a state of agricultural feudalism, which has been one of the chief retarding features in its development. The rural population is divided into two sharply contrasted classes, the wealthy landowners and their impoverished and ignorant laborers and tenants. Because of the vast distances, and because of the gulf fixed between the rich and the poor, Argentina has no such rural life to offer as the

Traveling over Argentina with the eye, we can learn as much as we could do in months of tramping and riding over the land itself. What a variety of climate and products this rich land presents, stretching as it does from the Tropic of Capricorn almost down to the northern limit of the ice-drift.

contained in the Easy Reference Fact-Index at the end of this work

United States, with its many schools and churches and social advantages. Of recent years the drawbacks of the old system have been recognized, and laws have been passed looking to the breaking up of the great estates and the creation of smaller holdings.

The Development of Argentina

Argentina's prosperity dates only from 1880. Before that time it did not produce cereals enough for its own use, and its meat exports were confined to Brazil and Cuba. Today the long-horned cattle of the early days have given place to white-faced Herefords and other pedigreed stock, just as the native *gauchos*, like the cowboys of the United States, are disappearing with the advent of more scientific farming. Argentina ranks third in the list of wheat-exporting countries, being exceeded only by Canada and the United States. In addition enormous quantities of frozen meats, hides, and wool are sent every year to Great Britain, the United States, and other countries, and nearly one-half of the world's flaxseed comes from this land.

In railway development the Argentine Republic leads all South American states with more than 23,000 miles. Lines radiate inland in all directions from Buenos Aires to the great wheat and cattle sections. River transportation is also available for many parts of the country, chiefly on the three great rivers, the Uruguay, the Parana, and the Paraguay, which unite to form the estuary of La Plata—one of the greatest among the river systems of the world (see Plata River).

Nearly one-fifth of the population is concentrated in the magnificent capital Buenos Aires, the foremost city of Latin America, exceeded in the western continent only by New York, Chicago, and Philadelphia. Through the great estuary of La Plata at its door plows a steady stream of liners from every quarter of the world, bringing swarms of immigrants and imports and taking away vast stores of meat and wheat. The rest of the country is sparsely populated, with only about six inhabitants to the square mile as compared with 30 to the square mile in the United States. Labor unrest, frequent strikes, and radical propaganda in recent years have awakened the statesmen of the nation to the perils of an overgrown city population and a sparse country population; and serious attempts are being made to break up the system of land monopoly and thus get more of the population into the country.

It is not likely that Argentina will ever become a great manufacturing center. So far as is known it contains little coal and iron, though it is believed that there are abundant supplies of petroleum still undeveloped. On account of the difficulties of mining operations and transportation in the Andes, the mining industry has been neglected, though there are a few rich deposits of silver, gold, copper, and a few other minerals.

Argentina more than any other Latin-American country is a white man's land, for the Indian population numbers only about 10,000 and the half-breed element only about 100,000. The white population is chiefly from Spain, Italy, Great Britain, Germany, etc. The language and customs are almost entirely Spanish.

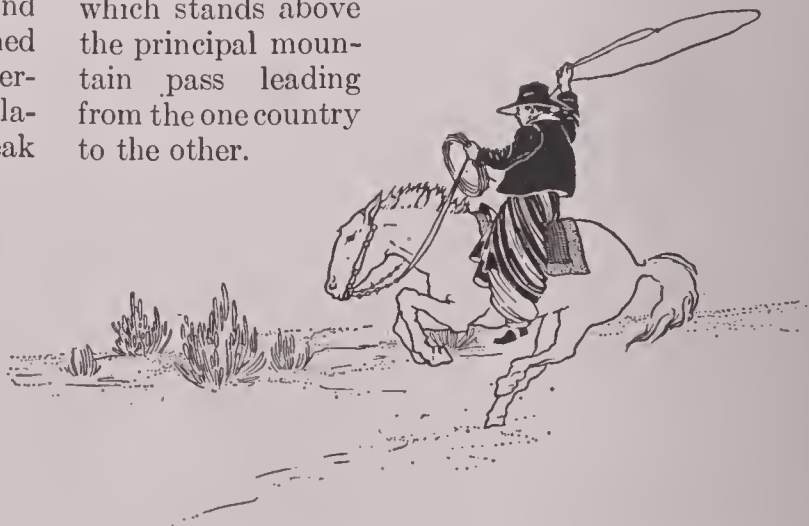
Argentina in History

Captain Juan de Solis (1515) and Sebastian Cabot (1527) were among the first Europeans to visit the region of the Plata River. In 1535 Don Pedro de Mendoza founded a settlement where the Argentine capital now stands, but it was soon destroyed by Indians. Seven horses and five mares escaped to the plains at that time and became the ancestors of the immense herds of wild horses that once roamed the pampas. In 1580 Buenos Aires was refounded and Spanish settlers began spreading over the country.

Argentina became the seat of a vigorous revolutionary movement against Spanish rule in South America as early as 1810. Desultory fighting went on for six years, until (in 1816) a revolutionary congress assembled and declared Argentina's independence. England and the United States were the first to recognize the new republic. Soon after, a patriotic army under General San Martin crossed the Andes—one of the greatest feats in military history—and helped Chile and Peru to shake off the Spanish yoke. Despite his military success, San Martin refused to accept civil office and withdrew to Europe.

A period of civil wars followed in Argentina which ended only in 1852 with the fall of General Rosas. In 1853 the republic adopted a constitution closely modeled on that of the United States. For a time there was a fierce war against Paraguay, in which Argentina, Uruguay, and Brazil were allied.

To commemorate the arbitration which ended troublesome boundary disputes with Chile, the two nations united in setting up the famous peace statue "The Christ of the Andes"—a colossal bronze figure which stands above the principal mountain pass leading from the one country to the other.



This is one of the *gauchos*, or Argentine cowboys, throwing the lasso. Darwin, the great scientist, tells in the story of his world voyage in the "Beagle" how he admired the skill of the *gauchos* and how, in trying to imitate them, he lassoed himself.

The Argentine Republic remained neutral throughout the World War of 1914-18. The Argentine congress, incensed by Germany's illegal sinking of Argentine vessels, voted by a large majority to break off diplomatic relations, but the president refused to take this step.

The government of Argentina is a federal republic. The provinces have their own legislatures and retain full authority in local matters, even levying taxes on interstate commerce. The president is elected for six years by electors chosen in much the same manner as in the United States. The national legislature consists of a senate whose members hold office for nine years, and a house of deputies elected for four years. The Roman Catholic faith is the state religion, but other worships are tolerated. There is a well-advanced system of primary, secondary, normal, and higher education, with a smaller percentage of illiteracy—about 50 per cent—than in any other South American country.

ARGONAUTS (*är'gō-nāts*). In Colchis on the distant shores of the Black Sea—so the old Greeks believed—there was once the fleece or skin of a wondrous sheep, all of pure gold, which was nailed to a tree in a sacred grove. By day and by night it was guarded by a sleepless dragon and by fire-breathing bulls, and in spite of its priceless value no mortal had ever braved these dangers to win it.

At last an adventurous youth named Jason, heir to the throne of Iolcus in Thessaly, made a vow to perform this dangerous task. With the aid of the gods he built an enchanted ship called the *Argo*, and accompanied by the noblest heroes of Greece—Castor and Pollux, Heracles (Hercules), Orpheus, and others—he set sail for Colchis. The journey was long and perilous, but the dauntless Argonauts (so called from the name of the ship and the Greek word meaning "to sail") overcame all obstacles and at last reached their destination.

The king of Colchis promised Jason the Golden Fleece if he would yoke to a brazen ploughshare the fire-breathing bulls, plow a field sacred to the god Ares (Mars), and sow it with dragons' teeth. From these, armed warriors would spring and seek to slay him. When these warriors were disposed of he must still fight with and slay the terrible dragon.

With the aid of the king's daughter Medea, a powerful sorceress who had fallen in love with Jason, the latter successfully performed these dangerous labors. A magic ointment protected him from the fiery breath of the bulls. The warriors were made to attack and slay one another. The dragon was put into a profound sleep by a magic potion, and Jason was enabled to draw near and cut off his frightful head.

Seizing the hard-won Golden Fleece, Jason fled with Medea to the good ship *Argo* and sailed back to Iolcus. The *Argo* was dedicated to Poseidon, the god of the sea, and was long preserved.

Jason, alas, proved untrue to Medea, and with

her magic she made for her rival a garment of wondrous beauty, but of such deadly poison that it burned like fire and proved a robe of death. When the frantic Jason rushed in search of the sorceress, she disappeared from view in a golden chariot drawn by dragons through the air.

ARGONNE (*är-gōnn'*) **FOREST**. During the night of Sept. 25, 1918, the 20 miles of war-worn trenches between the Meuse and the Aisne rivers, north of Verdun in eastern France, seemed to fill up mysteriously with gliding shadows. Whispered passwords and softly muttered orders told the French veterans who had been holding the line that the American First Army, fresh from its victory at St. Mihiel, was moving into position for battle.

A few yards to the north lay the formidable German defense trenches, which for four years had resisted all attacks. A cautious glance through a periscope from the French side might have shown beyond the barbed wire of No Man's Land the rounded silhouettes of concrete machine-gun emplacements, strung like beads along the Hindenburg Line. But the most menacing prospect of all confronted the Americans in the western part of the sector, between the Aire River and the Aisne. There the trenches wound through the double darkness of the rocky hills and ravines of the great Argonne Forest, and the soldiers knew that this was considered the strongest position of the enemy between the North Sea and Switzerland. Composed of tangled patches of trees and thicket, separated by clearings and pierced by a few straggling roads, it was a wonderful place to defend and a fearful place to attack. On the farther side of every clearing, at every turn in the roads, in every ruined farmhouse, the thick skull-shaped roofs of the German machine-gun nests were concealed—low concrete towers, half in and half out of the ground, presenting toward the American side only a narrow slit, several feet long but barely three inches wide, through which the guns were fired. Such "pill boxes" were impervious to rifle bullets, to shrapnel, to everything but a direct hit from a heavy gun, a thing almost impossible to achieve, as they were invisible a few yards away.

The Great Attack at Dawn

Suddenly from behind the 20-mile line, an earth-rocking roar shattered the night. Great whips of fire lashed the darkness as the American artillery in the rear laid down the barrage that was to break the way for the infantry's advance. For four hours the curtain of shells, screaming overhead, crashed down on the German defenses, while the German guns replied.

In the trenches, beneath this roof of flying metal, the Americans hitched up their belts and waited with bayonets fixed. Young lieutenants paced the "duck-walks" with their eyes on their wrist watches. The "zero hour," which was to mark the beginning of the attack and from which all the battle operations were timed, had been fixed at a few minutes before

dawn. As the great moment approached, a drizzling rain set in.

Just as the black of the east turned to the morning gray of September 26, the waiting troops saw the shadows of the pacing officers stop. A last glance at the glowing radio dials of their watches, then from one end of the line to the other the lieutenants sprang to the trench ladders, and their shouted commands could be dimly heard: "All right, let's go!"

Out of the trenches poured the waves of olive-drab soldiers, and forward through the uprooted barbed wire and the sea of shell craters, sweeping over the first line defenses of the enemy in the first bold rush. All that day they fought and the next and the next, capturing the "impregnable" machine-gun nests by the simple method of bayonet charges in the face of a hail of bullets. As one noted war critic wrote, the American soldiers "went where no other troops on the Continent would have gone." By the evening of September 28 they had penetrated from three to seven miles into the German lines, the greatest gain that had ever been made in a similar length of time against the foe's fixed defense system. Ten thousand prisoners had been taken and a score of villages captured, including the important points of Apremont in the Argonne Forest, and Cierges in the hilly country to the east.

Of the days that elapsed before the second phase of the battle opened, General Pershing wrote: "In the chill rain of dark nights our engineers had to build new roads across spongy shell-torn areas, repair broken roads beyond No Man's Land, and repair bridges. Our gunners, with no thought of sleep, put their shoulders to wheels and drag-ropes to bring their guns through the mire in support of the infantry, now under the increasing fire of the enemy's artillery."

Another "Battle of the Wilderness"

The second phase of the Argonne battle opened on October 4, with the fiercest fighting that had yet been encountered. The enemy had retreated to the famous "Kriemhilde Line," which had been fortified to withstand, as the Germans thought, any possible attack. Thrown out in front of this line were machine-gun companies, told that they were never expected back in Germany. The fighting resembled that in the famous "Battle of the Wilderness" of the American Civil War but on a much vaster scale. It was during this fight that the celebrated "Lost Battalion" of the American army pushed so far into the enemy lines that it was surrounded, but refused to surrender, and fought on for days without food or water until help arrived. The story of how a carrier pigeon helped to save these men accompanies the article on Pigeons.

The dash and courage of the Americans finally broke through the Kriemhilde Line, and on October 10 the Argonne Forest had been cleared of the foe, who retreated north of the Aire. On November 1 the final stage began with an early morning attack

north of the Aire. The result was the collapse of the entire German line between the Aisne and the Meuse. The battle turned into a pursuit race. The Germans fled back to Sedan, and on November 7 American troops appeared opposite that town, menacing the railway line through Sedan, which supplied the enemy's army. The British and French had won other great victories to the north and south and there was nothing now for the Germans to do but ask for peace. Four days later, on November 11, the armistice was signed (*see World War*).

During the Argonne battle, which was the greatest ever fought by American troops, the American and French artillery supporting the "doughboys" fired 3,408,000 rounds of ammunition, several times the amount consumed during the entire Civil War in the United States.

The American Divisions engaged in the Argonne battle were the 1st, 2d, 3d, 4th, 5th, 26th, 28th, 29th, 32d, 33d, 35th, 37th, 42d, 77th, 78th, 79th, 80th, 82d, 89th, 90th and 91st. Commanders: General Pershing, Lieut.-Gen. Hunter Liggett, Lieut.-Gen. Robert L. Bullard, Maj.-Gen. Joseph T. Dickman, Maj.-Gen. Charles P. Summerall, Maj.-Gen. John L. Hines, Maj.-Gen. George H. Cameron.

The Argonne Forest is a rocky plateau, partly wooded, in northeastern France, lying between the upper courses of the rivers Meuse and Aisne. It extends a distance of about 60 miles north and south, and has an average breadth of about 19 miles. The average elevation is 1,150 feet. The whole of this region was overrun by the Germans in August 1914, and the northern half remained in their hands until this battle in 1918.

ARION. According to the Greek legend the poet-musician Arion once owed his life to his power of song. He had gone from his home in Sicily to Corinth in Greece to take part in a musical contest, and had there won the prize and embarked for home laden with presents. The sailors, coveting his treasures, told him that he must either die by his own hand on shipboard or throw himself into the sea. Arion chose the latter, but begged permission to sing one last song. With his lyre in his hand and uttering a prayer to the gods, he then threw himself into the sea. But a crowd of dolphins had gathered around the vessel, charmed by the music, and one of these bore Arion upon his back safely to land. The poet Spenser draws this picture of the scene:

Then was there heard a most celestial sound
Of dainty music which did then ensue,
And, on the floating waters as enthroned,
Arion with his harp unto him drew
The ears and hearts of all that goodly crew;
Even when as yet the dolphin which him bore
Through the Aegean seas from pirates' view,
Stood still, by him astonished at his lore,
And all the raging seas for joy forgot to roar.

Little is known of the real Arion, but it is probable that he lived about 600 B.C. He is said to have invented the dithyramb, a form of choral verse.

ARISTIDES (*är-is-tī'dēz*). In ancient Athens, in the year 490 B.C., a curious scene one day took place in the market-place. The citizens were assembled to pass a vote of "ostracism" or exile on one or the other of their two leaders, Aristides and Themistocles; for

according to the laws of that time, whenever the rivalry between leaders became so bitter as to endanger the state, one of them might be sent into exile.

When the vote was being taken, an ignorant man who did not know Aristides by sight asked him to write for him the name "Aristides" on the shell which was used as a ballot.

"Has Aristides done you any injury?" asked Aristides.

"No," was the reply, "but I am tired of hearing him called 'Aristides the Just.'"

So Aristides was unjustly banished for ten years. It was his fairness and integrity which had won for him the name of "the Just," and in the battle of Marathon, at which time he was one of the ten generals of the Athenians, his example of giving up his command to Miltiades, the ablest of their number, had helped to win that great victory over the Persians.

At the end of his ten years of exile all Greece was

again faced with a terrible invasion by the Persians. Aristides returned to Athens on the eve of the battle of Salamis, and helped his rival Themistocles to win that great battle which destroyed the Persian fleet. He also commanded the Athenians at the land battle of Plataea the next year. When many of the states decided to form an alliance against Persia (the Delian Confederacy), with Athens at their head, Aristides, because of his well-known honesty and fairness, was chosen to make the arrangements and to assess the expenses of the war on the different states. Yet when he died, about the year 468 B.C., he

was so poor that he was buried at the public cost.

The Athenian government then tardily recognized his many services to Athens, and gave his daughters dowries and his son a landed estate.

ARISTOTLE (ă'rĭs-tŏt-l) (384-322 B.C.). On a summer afternoon in the year 366 B.C., a stranger, a slender youth of 18, approached an idler in the

market-place at Athens and inquired with a slight lisp the way to the house of Plato the philosopher.

"'Tis plain thou art a barbarian," replied the idler, smiling at the provincial cut of the stranger's mantle. "From what distant land dost thou come that thou art ignorant the great Plato has been beyond the seas for many months?"

"I am Aristotle, son of Nicomachus, who was physician to Amyntas, king of Macedon," said the youth. "I come from Stagira on the Strymonic Gulf to learn philosophy, not to listen to thy insults."

"A sharp lad, I see," replied the Athenian. "But wherefore dost thou take on such airs in Athens? Yet, if thou wouldst find the Academy in the master's absence, walk northwest through the Dipylon gate, follow the Cephissus River a mile or so to the suburb of the Ceramicus. There thou canst see a garden with a high wall. If thou hearest students making great talk beneath the trees, apply thy uncouth ear,

and if thou canst not understand a word of it, thou wilt know thou hast reached the place thou seekest."

The young man, scorning to answer the Athenian's insolence, went on his way, stealing wondering glances at the magnificent buildings and temples, and furtively watching the crowds and listening to the speech, for he knew his dress and accent marked him as a foreigner.

Far away in his northern home, while he was studying medicine with his father, Aristotle had dreamed of Athens, the illustrious center of the world's philosophy and art, and had determined to round out his schooling under the great

Plato, whose fame had reached to the far corners of the earth. When his father died leaving him a fortune, the youth stuck to his plan, and here he was at the entrance to the grove of the *Academia* (Academy) where Plato taught. Plato was away, would be gone for three years. Well, he would wait.

Meanwhile Athens lay before him. The political

YOUNG ARISTOTLE IN THE MARKET-PLACE



The market-places of ancient Greece, as you notice, were not at all like our market-places, with their warehouses and barrels and boxes piled about. They were decorated with statues and colonnades and were the centers for social and civic life as well as trade.

power of the city had been broken in wars with Sparta and Thebes, and already the menacing greatness of Macedon was looming in the north. But Athens still reflected the glory of the "golden age of Pericles." Idle luxury and youthful gaiety were arrayed on one hand; the best of learning beckoned on the other. Tyrants might rule, but intellect was free. Despite his wealth, the young Stagirite chose the serious life. He bought a house and began collecting a library.

During those three years of waiting for Plato, Aristotle became a man of the world. Keen, witty, logical, independent, he soon disposed of scoffers. When Plato returned, the master recognized the overpowering genius of his new pupil, a genius which was to shatter the Platonic doctrines themselves, which was to lay the foundation of new learning in the world, and win for the green lad from Stagira the name of being the greatest thinker who ever lived.

Teaches Alexander the Great

Aristotle remained 20 years in Athens, until the death of Plato in 347 B.C. Then he was called by Philip of Macedon to instruct his son Alexander, soon to become known as "the Great." For 12 years the philosopher remained with the future conqueror of the world, first as teacher, then as adviser and friend. During this time, while Demosthenes, born one year after Aristotle, was thundering his *Philippics*, warning Athens against the power of Macedon, Aristotle was sowing the seed of culture in the Macedonian mind. It was this intelligent influence that really saved Athenian civilization when the inevitable conquests came.

When Alexander set forth on his campaigns in

Asia, Aristotle returned to Athens and established there a school called the *Lyceum*, from its nearness to the temple of Apollo Lyceus. In this school was a promenade called *peripatos* in Greek, and from the master's habit of walking here as he talked to his pupils, his teaching came to be known as the *peripatetic* philosophy.

After the death of Alexander the Athenians revolted, and although Aristotle had taken no part in politics, his early associations with Macedon were seized upon by his enemies. He was accused of impiety, the same charge upon which Socrates had been put to death 76 years before. Aristotle fled to Chalcis in the island of Euboea, in 323 B.C., where he died the following year at the age of 63.

The life of Aristotle was not a sensational one. He did not upset the world of his day, nor did he electrify his fellows with clever sayings or strange manners. He was above all a student. His amazing brain grasped at the whole field of knowledge. He was not only a deep thinker, but a careful observer, "a philosopher of facts," an organizer and systematizer of knowledge, whose greatest service was to establish science and philosophy on a substantial basis. By defining and classifying the various branches of knowledge—as Physics, Metaphysics, Psychology, Ethics, Politics, Rhetoric, Poetics, and Logic—he laid the foundation of all the sciences and philosophies of today.

Many of Aristotle's writings have disappeared and others have been ascribed to him which he probably never wrote. Of those that remain some of the best known are: Treatises on Logic (known as the 'Organon'); 'Rhetoric'; 'Poetics'; 'History of Animals'; 'Metaphysics'; 'Physics'; 'De Anima' (Psychology); 'Nicomachean Ethics'; 'Politics'; 'Constitution of Athens'.

INTERESTING FACTS *about* ARITHMETIC

ARITHMETIC. So important is rigid and accurate arithmetic in business that machines have been invented which "do sums" mechanically. Among the most common of these is the *adding machine*. In using it, all that is necessary to do in order to get a correct sum is to press certain keys for the numbers and then pull a lever. The machine prints the answer on a roll of paper and it makes no mistakes.

Besides the adding machine there are machines that not only add, but subtract, multiply, and divide. There is also in use in many industries the slide rule, upon which by sliding sections to given numbers, the numbers can be multiplied or divided.

WHEN men first learned to count, Arithmetic was invented, for Arithmetic is merely the knowledge of numbers and their use. It enters into our daily lives in telling time, in making change, and in all forms of measuring. It is used to keep score in games. It comes into cooking, sewing, gardening, and other occupations of the home. It is necessary to the farmer, the man who works at a trade, the merchant, and to men and women in the professions. In this article are not only many interesting facts from the history of Arithmetic, together with a few quaint old problems; but also up-to-date suggestions for becoming rapid and accurate in performing arithmetical processes.

Another helpful invention is a new form of computing weighing scale, which may be seen in many grocery stores and meat markets. This scale gives the prices by the pound and the fractional part of a pound, so that in finding the amount to charge for a purchase, all that a clerk needs to do when

weighing an article is to look where the indicator on the scale points.

But with all the new inventions it is still important that arithmetic be studied and mastered. The reason for this is, not only that it is necessary to compute when there are no machines at hand, but because arithmetic in itself gives you a valuable training. It develops power in thinking clearly, it

THE PROBLEM OF THE BOATMAN

A boatman had to ferry across a stream a wolf, a goat, and a basket of cabbages.

His boat was so small that only one of the three besides himself could be contained in it.

How was he to manage so that the wolf should not be left with the goat or the goat with the cabbages?



*Here is the Boatman
Can you solve the problem?*

THE OLDEST PUZZLE-PROBLEM OF ALL

As I was going to
St. Ives

I met a man
with seven wives,
Each wife had
seven sacks,
Each sack had
seven cats;
Each cat had
seven kits;

Kits, cats, sacks, wives,
How many were going
to St. Ives?

"I met a man with seven wives"



develops accuracy, it helps in acquiring habits of neatness, it serves as a training in concentration and perseverance, and, moreover, it gives a person the confidence in himself that comes from good habits, and a consciousness of knowledge of a practical kind. Arithmetic is in fact an important key in winning success.

To know how methods of computing have been improved, and to realize the importance of arithmetic in advancing civilization, it is necessary only to glance at its history.

How Long the World Has Been "Doing Sums"

A knowledge of arithmetic of a simple kind goes back thousands of years. It was known among the ancient Chinese, the Babylonians, the Egyptians, and the Greeks, long before the Christian era; but arithmetic as we know it is only a few hundred years old. It was not until the Hindus had worked out what we call the "Arabic system" of numbers that modern methods of computing could be developed (see Numerals).

The Arabic notation in its present form, with its *zero* and convenient "place value" of figures (units, tens, hundreds, etc.) was invented by the Hindus between the 5th and 6th centuries A.D. It was carried into countries along the African coast, and reached Spain early in the 12th century. From the East and from Spain it was taken by traders into Italy and other European countries. It did not, however, come into general use in Europe until the 16th century.

Before the Arabic notation came into use in the principal European countries, numbers were usually written in the clumsy Roman notation, and most computing was done with pebbles or counters on lines drawn on a board. In the picture the line at the little girl's right hand stands for units, the next for tens, the next for hundreds; the line for thousands which comes next is marked with a cross. The spaces between the lines were used for fives. This instrument was called an *abacus*, later forms of which consisted of beads strung on wires. Similar ones are in use today in China, Japan, and certain parts of Russia.

Since both science and trade are dependent upon arithmetic, neither could make great advance until such primitive methods of computing together with the clumsy Roman notation which usually accompanied them were replaced by the Arabic forms and more modern arithmetic. For this reason we find that from the 13th through the 16th century, when the world was making rapid advance in learning and in navigation and trade, there was a great demand for improved methods of computing.

The first arithmetic to be written advising the use of the Arabic notation was one written by an Italian in 1202. The first arithmetic to be printed was

written in Latin, and came out in Italy in 1478, a few years after Gutenberg invented printing and shortly before Columbus discovered America. Other early arithmetics were printed in 1484 and in 1496.

Some Quaint Old Problems

These early arithmetics included our modern ways of adding, subtracting, and multiplying, together with seven other methods of multiplying and several ways of doing division. The problems contained in the early arithmetics were often curious in character. Here are three of the many famous ones:

Market Problem.—A woman going to market with a basket of eggs found that when she counted them by two's there was one over, but when she counted them by three's there were two over. The whole number was between 50 and 60; how many were there in the basket?

"God Greet You" Problem.—God greet you with your 100 scholars! We are not 100 scholars; but our number and the number again and its half and its fourth

are 100; how many are we?

Chess-board Problem.—Required, the number of kernels of wheat needed in order to place 1 kernel on the first square of a chess-board, 2 on the second, 4 on the third, and so on for the 64 squares. Answer: 18,446,744,073,709,551,615 kernels.

In the schools where these arithmetics were used, there were no recitations in arithmetic. Each student worked by himself. In some of the Latin schools arithmetic was studied only in the fifth and sixth years, and then only one hour a week was given to it. In the trade schools much more time was given to arithmetic, but even in these schools the work consisted in memorizing long rules and working difficult and often tedious problems. Little was known in these days about teaching.

To aid the memory, some of the early arithmetics have the rules in rhyme. One of these rhymes that is still in use is the familiar one beginning:

Thirty days hath September,
April, June, and November.

The arithmetic studied in the schools of today is simpler, more practical, and more easily mastered than that of olden times. Yet it should be remembered that these early books contained, along with material long since discarded, most of the modern methods of computing, and that the modern world owes to their authors, and the Hindus before them, a great debt of gratitude.

How Arithmetics Have Improved

Until very recent years the principal change in the teaching of arithmetic, as a result of modern educational thought, consisted in a growing willingness to omit topics that had no close relation to our own lives. For instance, topics now wholly omitted or neglected are the surveyor's table, apothecaries' weight, and troy weight; greatest common divisor and least common multiple as special topics, complex and compound fractions (except those of a very simple nature), annual interest and most of compound



interest, partial payments (except under the United States rule, and with problems involving common amounts, as a principal of \$100 with payments like \$10 and \$25, rather than amounts like \$251.42 and \$19.79), profit and loss as a special topic, equation of payments, partnership, longitude and time (except problems based on the 15° scheme and a few others), and cube root. The conviction has been growing that there are too many arithmetical topics which are intimately related to our lives to allow time to be spent on others that lack such relationship.

But more recently new topics have been accepted and other older ones have been receiving a new emphasis, according as such topics are intimately concerned with our welfare. For example, new topics or topics newly emphasized are insurance, stocks and bonds, government revenues and expenditures, the banking business, and taxes. These are subjects for children studying somewhat advanced arithmetic. But a similar change is also affecting the problems for younger pupils. Problems dealing with actual situations are more and more in demand for pupils of all ages, such as those dealing with farming, fishing, lumbering, mining, manufacturing, transportation of goods, trade, and facts of daily interest.

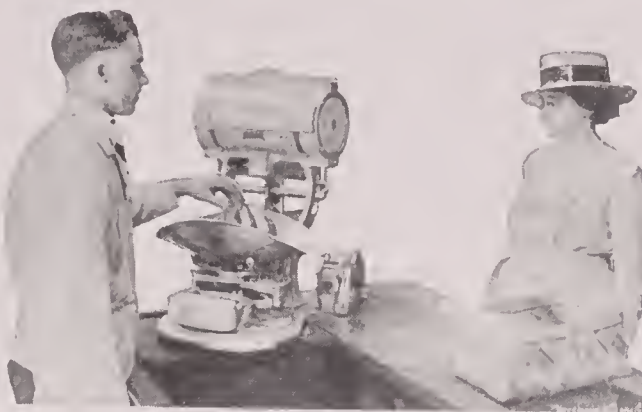
In general in the study of arithmetic pupils are tempted to "figure" too much, and to allow the

formal side to dominate the "thinking" side. Often they should (1) read a problem a second or third time carefully, to get the exact conditions; (2) then restate the problem in their own words, to make fully sure that they understand its condition; (3) state the number of steps required for the solution and show the character of each; (4) then give the approximate answer. Figuring for the correct answer frequently can be omitted. Nevertheless it cannot be too strongly insisted upon that a complete and instant mastery of the "fundamental facts" (or tables) in addition, subtraction, multiplication, etc., is necessary to success in arithmetic.

To assist in attaining this, use should be made of the drill exercises given in the articles on the separate processes (*see Addition; Division; Multiplication; Subtraction*).

Aside from such drill it is hardly wise to allow children to receive help upon their arithmetic at home. The reason for this statement is that parents and other home friends usually have different ways of solving problems from those employed at school. Sometimes these home methods are worse, sometimes better, than those used at school. But they are almost bound to be a source of confusion. It is generally best, if home help seems necessary, for the helper to try to understand and follow the school method.

DOING SUMS BY MACHINERY



This is one of the computing scales such as you see in grocery stores. All the clerk has to do is to put the article sold on the scales and a little arrow points to the total price—the result obtained by multiplying the weight by the price.

The WONDERLAND of the AMERICAN SOUTHWEST

ARIZONA. The state of Arizona—the newest star in the American flag—is a land of amazing contrasts, for within its borders are found extremes of altitude, extremes of tem-

perature, and extremes of rainfall surpassed in the United States only by California. From the shifting sands of the southern deserts on the Mexican boundary where the thermometer often reaches 130 degrees in the summer, it is only a few hours' ride by train to the mountains where snow lingers for seven months of the year and the winter temperature drops to 20 below zero.

Nowhere in the United States do old and new jostle each other in sharper contrast. Thirty or forty years ago, most of the cities were mere mining camps—wild, rude, and lawless. Today they are prosperous

Extent.—Area, 113,956 square miles (fifth in size among the States); nearly 350 miles square. About one-quarter of the State is national parks, Indian reservations, etc. Population (1920 census), 333,903.
Natural Features.—Numerous short isolated mountain ranges running northwest and southeast (highest point, in San Francisco Mountains, 12,794 feet); Painted Desert, Petrified Forest, and Grand Canyon of the Colorado in the northern part. Chief rivers, Colorado, Little Colorado, and Gila.
Chief Products.—Copper, gold, silver; long-staple cotton, hay, wheat and other cereals, fruits, and vegetables in irrigated valleys of the southwest; cattle and dairy products; timber.
Chief Cities.—Phoenix (capital, 30,000 population), Tucson, Bisbee.

intelligent communities with handsome buildings and excellent schools. A generation ago the large population of native Indians was still an object of dread, breaking out in occa-

sional fierce forays upon the settlers, as their ancestors had done for centuries past. Today the natives have settled down in unbroken peace on the great reservations set aside for them, and are contributing to the prosperity and upbuilding of the state by tilling the soil and raising cattle. On every hand are vivid reminders of the historic past—here the quaint old mission buildings of the Spanish priests; and there the ruined cliff-dwellings, aqueducts, and fortifications of a still older civilization.

To get a picture of this land, imagine a tract roughly square in shape and about 350 miles each



THE GREAT ROOSEVELT DAM



This is the great Roosevelt Dam near Phoenix, Arizona, a part of the irrigation systems which have done for the dry but extremely rich lands of Arizona what Father Nile has for centuries been doing for Egypt. This dam has reclaimed nearly a quarter of a million of acres in the famous Salt River Valley. It curves upstream because, on the principle of the arch, this form best resists the great pressure of the water. It constantly broadens toward the bottom because the pressure of the water increases in proportion to its depth.

way. The northern portion is a high plateau, from 5,000 to 7,500 feet above sea-level, with mountain peaks and ranges rising here and there, and gashed and scarred by canyons and gullies which the snow-fed streams have been carving for millions of years.

A Land of Natural Wonders

The greatest of these, the Grand Canyon of the Colorado, is one of the wonders of the world. Through a deep cut between cliffs from 1,000 to 6,500 feet high, the muddy river flows for 400 miles, appearing from the rim above as a mere ribbon sparkling in the noonday sun (*see* Grand Canyon).

In this region, too, is the Painted Desert, with the brilliant reds, browns, yellows and purples of its clays and sandstones, giving the appearance of a vast canvas on which some more than human artist has splashed his colors. And here in the desert is the Petrified Forest, a tract of 60 square miles, strewn with the petrified logs of an old old woodland, felled by prehistoric storms and turned to jasper and onyx and chalcedony during the thousands of years when this whole region was buried beneath the ocean. Everywhere are *mesas*, great solitary flat-topped masses of sandstone, their steep sides carved into clefts and pinnacles by the storms of countless ages.

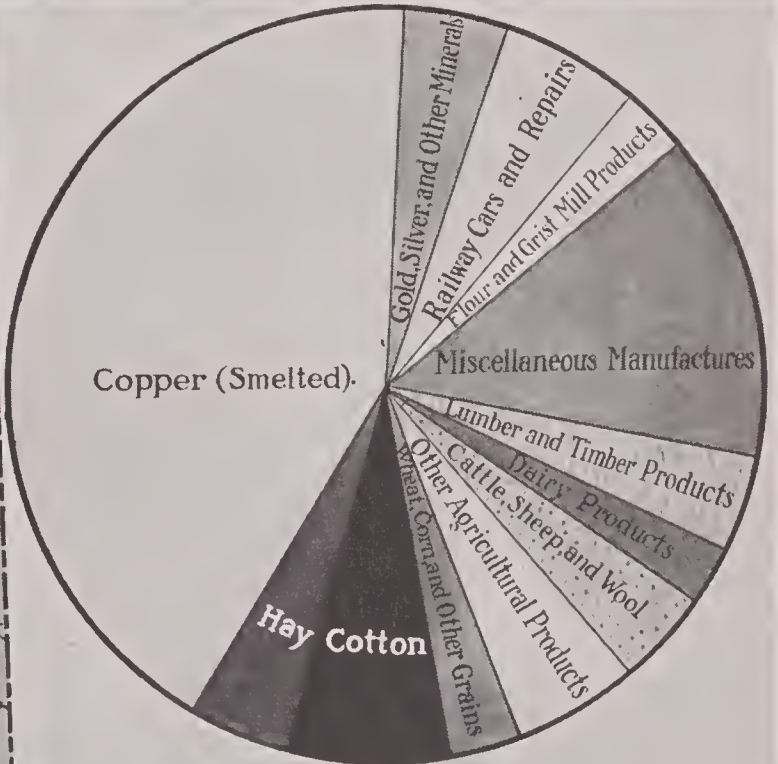
Across the state from southeast to northwest runs an irregular belt of mountains, 70 to 150 miles wide,

many of whose peaks are extinct volcanoes. On the south this dividing ridge pitches steeply off to a general altitude of about 3,000 feet. From there on the land slopes gently to the south in great plains broken with valleys, and with detached mountain ranges and solitary peaks.

The diversity of surface gives Arizona an equally varied climate, but one which is delightful and healthful everywhere, save in the deserts of the southwestern corner, where the heat is excessive. Here lies the city of Yuma, one of the hottest cities of the United States. But the nights are invariably cool, since the heat radiates rapidly in the excessively dry air.

Arizona gets little rain because the high mountain ranges of the Pacific coast intercept the moisture from that ocean. Most of the rain-clouds which reach it are blown up from the Gulf of Mexico. These have a long way to travel and are usually pretty thoroughly emptied before they have crossed Texas. On the average 292 days out of the year are cloudless. The dry climate and constant sunshine are so healthful and beneficial in cases of lung trouble that great numbers of sanitariums have been built for such sufferers, who come to the state from all parts of the country. On account of the clearness of the air Dr. Percival Lowell, the noted astronomer, chose Flagstaff for the observatory where he made his famous studies of the planet Mars.

PICTURE STORY OF ARIZONA



In this picture group you see some leading facts in the geography, history, and industry of Arizona, together with other striking features. In the bird's-eye view you find among other things, the location of the Grand Canyon, the Painted Desert, the Petrified Forest, and the routes of the early explorers. The map shows the location of the various Indian reservations, national monuments and parks, and the railroad lines by which they are reached, together with the rivers and other natural features indicated in the bird's-eye view. From the circular diagram we see at a glance that the greatest natural resource of Arizona is its copper, which is almost as valuable as all its agricultural and manufacturing interests combined.

contained in the Easy Reference Fact-Index at the end of this work

Despite the scanty rainfall, the state has an interesting and varied plant and tree life. Most characteristic is the desert vegetation—the cactus, mesquite, agave, yucca, canaigre, and sagebrush. More than 100 varieties of cactus are found in Arizona, ranging from the giant eactus 20 to 40 feet high down to the little prickly pears. Many of these are edible, and one variety, the barrel cactus, has saved many a life by the store of moisture found in its pulpy interior. Cattlemen have learned how to cut down one tender variety, burn off the spines, and feed it to cattle in time of drought.

Grasses of many varieties abound in many parts of the state, especially the north, furnishing excellent fodder for cattle and sheep. Some varieties seem to be almost independent of rainfall, and flourish except in times of very exceptional drought. On the mountains are great forests of pine, juniper, cedar, fir, spruce, and other valuable woods, most of which are set aside as forest reserves.

No less varied is the animal life of Arizona, ranging from coyotes, mountain lions, deer, antelopes, and wild cats in the north, to such typical creatures of the desert as scorpions, tarantulas, and the venomous Gila monsters—the only poisonous lizard known. Rattlesnakes and other reptiles are found in many places, and there are many kinds of birds—from the quail and wild turkey of the mountains to the tiny humming-birds, of which Arizona has 14 species.

What Irrigation Has Done

Under irrigation large parts of Arizona are becoming valuable agricultural land. The soil of the valleys is rich and marvelously fertile, producing Egyptian cotton of marvelous quality, wheat, barley, sugar beets, alfalfa, hay, fruits, vegetables, and other temperate and semi-tropical products in astonishing profusion when supplied with water. Arizona leads the nations in the yield of its hay crops per acre, and from three to five crops of alfalfa can be grown every year. But only about 2 per cent of the total area is under cultivation, and the future of Arizona's agriculture depends on reclamation projects. The Roosevelt Dam, near Phoenix the capital, has reclaimed nearly a quarter of a million acres in the famous Salt River valley, which lies in the heart of the southern lowlands of the state. The great weir dam near Yuma, where the Gila River flows into the Colorado, has wrested another 100,000 acres from the desert. When the various projects under way are all completed, it is estimated that 2,000,000 acres will have been reclaimed.

Stock-raising is still a leading industry of the state, which contains some of the greatest cattle ranges left in the country. The cowboy is making his last stand in these great unsettled regions, but his days here as elsewhere are numbered. Gradually the great ranges are being broken up into small homesteads, and converted into dairy farms and tilled lands.

Arizona's chief source of wealth is still in its mines. One out of every four of its adult males is engaged

in some phase of the mining industry, and the total value of its mineral production is in some years greater than the production of any other state in the union. Arizona is the greatest copper producing region in the world, and it also produces large quantities of gold, silver, lead, as well as some of the rarer minerals. Bisbee is the greatest copper mining center, and Douglas, the "Smelter City," smelts great quantities of ore from Bisbee and from Mexico. Arizona also has untouched coal deposits of vast potential value.

Arizona is still one of the most scantily populated states, having only a little more than two inhabitants to the square mile. In area it is the 5th largest state, but in population it ranks 45th. A large proportion of the white population is made up of the Latter Day Saints or Mormons, who came down from Utah and composed the first wave of agricultural pioneers.

The most interesting element of the population is the Indians, of whom 30 tribes are represented in the Indian schools. Chief of these are the Navajos (*náv'a-hōs*), famous for the artistic skill with which they weave blankets and fashion silver ornaments. The Hopis are a peace-loving and highly developed race, remarkable for the tenacity with which they retain their ancient tribal customs, such as the rattlesnake dance in which the performers hold live snakes in their mouths. The Apaches, once blood-thirsty and treacherous, the most dreaded foes of the settlers, are now chiefly famous for their cleverly woven baskets. Scattered over the state are the ruined cliff-dwellings and *pueblos*, in which formerly dwelt thriving Indian communities of a relatively high degree of culture (see Cliff-Dwellers; Pueblo Indians).

The first Europeans to explore the territory now included in Arizona were probably Fray Marcos of Niza and a negro companion called "Little Stephen" who traveled northward from Mexico in 1539 to the Zuñi villages. The negro was killed by the Indians—the first of a long line of tragedies marking the early history of Arizona; but Fray Marcos undaunted returned in 1540, to act as guide for the famous expedition of Coronado. Reports of fabulous wealth stored in the "Seven Cities of Cibola," as the region of the Zuñis in New Mexico was called, fired the explorers to press on in spite of hostile tribes and other difficulties. Coronado spent many months in the quest, but no gold was found. Other adventurers met with the same ill success.

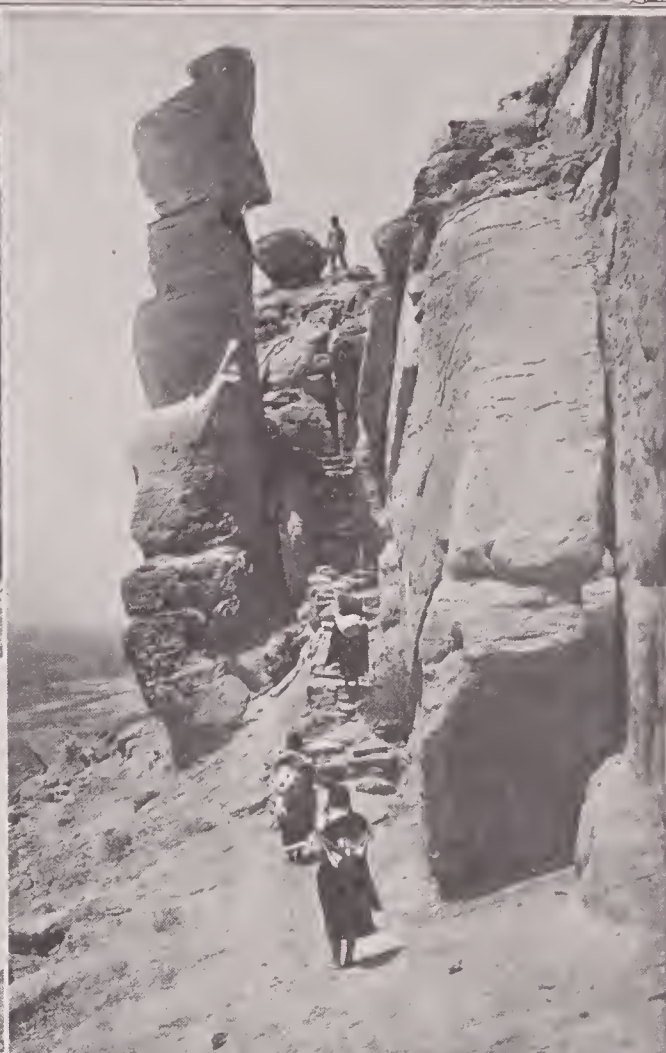
During the 17th and 18th centuries some progress in Christianizing the natives was made by the rival efforts of Jesuit and Franciscan missionaries. Two of the early missions still stand. But settlement was slow, and the first important city to arise was Tucson, established as a *presidio* (garrisoned post) in 1776.

Under Spanish and Mexican rule Arizona was considered a part of New Mexico. The first considerable wave of white immigration came in during the first quarter of the 19th century. In 1848, as a result of

NATURE'S ENGINEERING IN ARIZONA



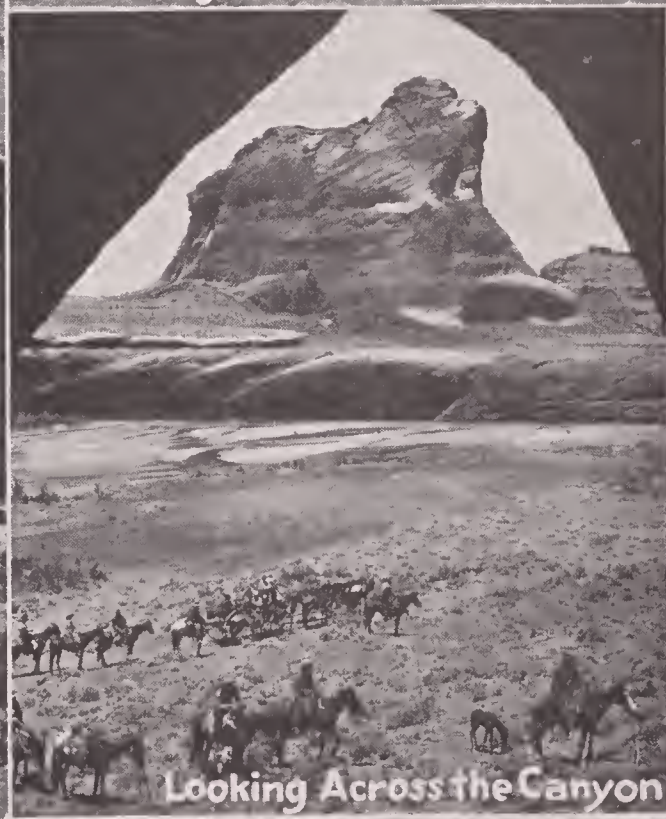
The Rainbow Bridge



Taking the Elevator in "Hopiville"



The Monuments



Looking Across the Canyon



The White House of an Ancient Chief

Ages before man undertook such engineering feats as the Roosevelt Dam, Nature was busy upon such examples of architecture and engineering as you see here. The Rainbow Bridge was carved by running water. The "Monuments" in the next picture were once part of great rock masses. Frost, water, and wind gradually wore away the softer parts of the rock, leaving these fragments standing. That is also the way the great mesa in the lower right-hand picture was made, and the "leaning tower" above. Notice how rude steps have been made in the incline leading to the pueblos of the Hopi Indians above. In the lower left-hand picture notice the castle-like dwelling of some ancient chief perched in an almost inaccessible cave, well up the side of the cliff.

contained in the Easy Reference Fact-Index at the end of this work

the Mexican War, the United States gained both New Mexico and the part of Arizona which lies north of the Gila River. In 1854 the remaining part, south of the Gila, was obtained from Mexico by the Gadsden Purchase. In 1863 Arizona was made a separate territory. Women were granted full suffrage in 1912, the same year in which the territory acquired statehood. Prohibition was voted in 1915.

Though the newest of American states, Arizona is one of the most progressive. Provisions have been written into the constitution for the initiative,

referendum, and recall. Laws have been passed regulating the employment of women and children, fixing a minimum wage for women, and providing for employers' liability and compulsory compensation for workmen engaged in dangerous occupations. There is a state university at Tucson, and two normal schools. The percentage of illiteracy is high—more than 20 per cent—due to the large Mexican population; but liberal appropriations have been made by the legislature to Americanize and educate foreigners in night schools.



BAYETA (*bāy-ē'tā*) was a little Navajo (*nāv'a-hō*) Indian girl. She lived among the mountains of northeastern Arizona, but not always in the same place. In that high dry country there is little game for hunters and few places for gardens. By living in small groups and moving around, the Navajos can find enough water and grass for flocks of sheep. So they are wandering shepherds and not village Indians, like most tribes. And, as they have little else to work with beside wool, the squaws spend their time weaving beautiful blankets and rugs.

In the winter Bayeta's family group lived in round earth-covered huts on a *mesa* or high tableland in the midst of the desert. She was always glad when spring came. Then they all went up into a deep narrow rock-walled valley or canyon to live during the long hot summer. The braves and boys and dogs went before to drive the sheep. The squaws, papooses, and pack horses and ponies followed. Old people and young children were allowed to ride.

Down, down, down from the high mesa they journeyed, over a narrow winding trail. At last they

reached the grassy canyon. It had a spring of clear cold water. The bank of a little stream was shaded by cottonwood trees. There was a peach orchard, pink with bloom. High on a rock shelf of the canyon wall stood a street of empty houses, built by the cliff-dwellers. They were of stone and so well built that they had stood there for hundreds of years. But the Navajos would not use the houses of those strange people who had died so long ago. They thought it would bring bad luck. Besides they liked to be down on the grassy floor of the valley.

Bayeta's grandfather, father, uncles, brothers, and cousins built a summer hut of poles and bark in three days. It was just large enough for cooking and for everyone to sleep in. The squaws made a fire under the smoke hole and put on a big kettle of mutton stew. They made corn bread and coffee. When they had rolled up the blankets and sheepskins used for bedding, the housework was done.

Everyone had to work. The braves and boys and dogs went out with the sheep. The strong young women made a garden. The little girls took care of the babies. The older



Bayeta probably had a doll like this, for the little Navajo girls of today have just such dolls.

women did the cooking and worked at their looms. Bayeta had no papoose to mind, so she helped her grandmother get ready to weave a blanket.

There was so much to do, and that is why the Navajos must charge high prices for their blankets. After the sheep were sheared, the fleeces of wool have to be beaten and shaken free of dust and picked clean of twigs and burs. Then Bayeta and her grandmother had to go out on the desert and dig the soapy roots of the yucca plant to wash the fleeces. The little girl sat on the ground and pulled the snowy fleeces apart into little bunches. Her grandmother combed the wool between wire brushes, and spun and twisted it into yarn with a spindle. Two, three, even five times, she spun the yarn, until it was fine and smooth and evenly twisted.

When she had enough yarn for her blanket she dyed it many colors.

To dye red she had dried cochineal insects from Mexico, and for blue she had lumps of indigo. These she had bought of a blanket dealer. The other colors she made herself. She and Bayeta gathered big baskets full of the bright golden flower heads of a yellow aster. A light yellow could be made from peach leaves, a dark yellow from chips of rabbit wood. For black there were sumac leaves, a yellow clay, and the gum of the pinyon pine tree, all boiled together. Earths with salt and alum in them were needed to "fix" the colors so that they would not fade. For days and days Bayeta's grandmother chopped roots, and pounded bark and leaves, burned gums to ashes, and boiled and fixed and strained her dyes. At last she had earthenware pots full of clear bright colors.

Soon the thorny shrubs of the canyon were gay with skeins of rainbow hues. Bayeta wound the yarns into balls while her father set up the loom. In the pleasant shade of a cottonwood tree he drove two stout posts into the earth. Across the top and bottom he tied stout beams. This was the loom frame. Her grandmother made a "warp" frame of four slender poles, bound at the corners. On this she wound plain white "warp" threads, very close

together, from top to bottom. Then she laced the warp frame into the loom frame with ropes, and stretched the warp threads tight. Squatting on a sheepskin in front of the loom, she began to weave in the colored filling yarns, working from the bottom.

She had no pattern to follow. All winter she had

been thinking of the blanket and making a picture of it in her mind. She liked to talk to Bayeta about it.

"Look, Bayeta," she said to the little girl. "This is how I will make my blanket. Red is the color of fire and of the sun. Black is for water—rain. Those are the colors of life. Without heat and moisture there is no life. There is more sunshine than rain on the desert, so my blanket will have much red in it. But there will be a great deal of black in it, too. Black is the color of the north, of mountains, storm

clouds, men, and of all rough strong things. It is the color of mourning too, of sorrow and bad luck.

Life Story the Colors Tell

"Blue is the color for women and of the soft clear southern sky. Yellow is for the west, the setting sun, the end of the journey. Green is for spring, youth, hope, and for little valleys like this. Brown and gray are for decay and death, for the waste places of the desert. White is for the east, for fresh morning, childhood, and innocence."

"Why, grandmother," said Bayeta, "you can tell a story with colors."

"Yes, little one, you must know the meaning of colors, or you can never weave a good Navajo blanket. Our patterns have a meaning, too.

"Every line and stripe, square and diamond, triangle, cross, zig-zag, and fret has a meaning. A broad angle is for the arching sky. A sharp angle turned upside down is a whirlwind. Lines and bands are trails and roads on the journey of life. A square is the symbol of the four winds or the four seasons.

"A row of small squares joined by straight lines shows the houses of related families. A diamond is the country of a group of families; if stair-stepped it is a mesa rimmed with mountains. Zig-zags are for lightning; if tangled together, for serpents. A straight line with dropping bars is a raincloud.

RUINS OF A CLIFF-DWELLING



Here are the ruins of one of those cliff-dwellings beneath a hanging rock that Bayeta's people felt superstitious about. And no wonder! We wouldn't want to live in such mysterious old ruins either, would we, with their memorials of strange people lying about, pieces of broken pottery and fragments of woven cloth, and the ashes of ancient fires.

WHERE THE NAVAJO BLANKETS ARE WOVEN



In "woolen mills" like this, where the entire "plant" consists of a crude hand loom, the finest of Navajo blankets are made, some of them selling for several thousand dollars. These Navajos have set up their loom in a canyon. A rug 5 by 10 feet, say, requires a month for making, while a very large rug will take a whole year. The Indians supply everything for the work. The wool comes from their sheep and they make the dye from herbs. Usually two work to a loom, one combing the wool and spinning the yarn, the other doing the weaving.

Frets are for mesas and canyons. A cross of narrow lines shows an enemy on the trail. The *swastika* cross (thus, ) is for good luck."

All summer Bayeta waited on her grandmother as she sat on her heels before the loom, pushing rude shuttles of colored yarn between the warp threads to form the pattern in her mind. The old squaw chuckled over happy memories or shut her lips tight over sad ones. Bayeta often sat beside her.

"There, little one, is the mesa where I was born, with mountains around it. Here is the desert with its endless trails. Here the green little canyon. Seven families stayed together. Here are their summer 'hogans' (huts), tied with a strong bond of love. Here is the stream in which my lover and I washed our hands when we were married."

"Are you weaving the story of your life, grandmother? How beautiful! What will you do with your blanket when it is done?"

"It must be sold. Our gardens grow little food. We need clothing. We have no reeds to make baskets. We have to buy our cooking and dye pots of the Pueblos. We must buy coffee and meal of the trader. Bayeta must have some good shoes and a red calico dress, and a book for the government school."

"No, no, grandmother. I want none of them. Your blanket is a part of you. It's your story, your book, your heart. Whoever buys it cannot read it. He will just see colors and figures. We see in it the story of your whole life."

How Bayeta Got Her Name

"Never mind. I can make another next year, and it will be different because I shall have lived another year. The most beautiful rug I ever wove was for my wedding. It was all red and black, blue and green and white. It was a famous *bayeta*. You were named for it. Hard times came and it had to be sold. As I grow older and older, there is more brown and gray and yellow in my blankets. The colors and pattern are memories. Over and over I weave my story, and as the moons go by, the story changes. Now this blanket is done. I'll make four strong black tassels at the corners to tie my life to the four corners of the earth."

When the blankets of all the squaws were finished they were hung on ropes for everyone to admire. The poorest plainest ones were kept for bedding. The fine ones were carried away to be sold. Bayeta rode to the traders with her grandmother. They had a pony load of food and clothing to fetch home.

But they were both sad. That night Bayeta slept close to her grandmother. The dark hid her tears.

"Grandmother," she said, "your blanket was the most beautiful of all. When I grow up I'm going to weave one just like it."

"No, little one, you cannot remember the pattern. You will weave your own story. Every life is different, and everyone changes with the years. That is why no two Navajo blankets are ever exactly alike."

FARMS, FORESTS, and MINES of the "BEAR STATE"

ARKANSAS (är'kän-sq).

In the whole state of Arkansas, which is a little larger than New York state, there are not so many people as in the single city of Philadelphia. Yet this state, three-fourths of which is covered with forests, probably has as great a variety of products as any other state in the Union. On account of the varying height of its land, nearly every crop that is grown from the Great Lakes to the Gulf of Mexico can be found there.

Nearly every mineral is mined in the mountainous regions, and the state is noted for producing about one-half of all the aluminum ore (bauxite) produced in the world. It has one of the few diamond mines outside of South Africa, and its industries include the raising of ostriches. The Arkansas diamond mine is located in Pike County, and since it was first opened, in 1906, about 2,000 stones have been found.

Arkansas is also noted for its whetstones, and every workman who has to sharpen tools knows the value of the stones made from the rock called *novaculite*, found in the Ouachita Mountains in the western part of the state. The making of these whetstones is an important industry in seven counties. Among other minerals that are profitably mined are coal, iron, and manganese. Natural gas in small quantities is found in several places.

The "Big Three" of Arkansas

Cotton, corn, and timber, however, are the "big three" among the state's products. The value of the cotton crop is more than half the value of all the other crops combined. Arkansas also has a big apple crop and many other fruits are grown. Interesting experiments have also been made in the growing of rice. For this purpose the government undertook to irrigate certain lands near Little Rock, and obtained the largest rice yield per acre in the United States.

With so large a forest area it is not surprising that Arkansas has some of the largest sawmills in the world, and the largest car factory. The timber resources have only been touched, and a great share of the wooded area has been taken over by the government as forest preserves. The trees include almost all the principal soft and hard woods grown in America—about 100 varieties altogether.

Arkansas boasts more mineral springs than any other state, one of them discharging 9,000 barrels of

Extent.—North and south, about 250 miles; east and west, from 175 to 275 miles. Area, 53,335 square miles. Population, (1920 census), 1,752,204.

Natural Features.—Ozark Mountains in northwest; chief ranges, Boston and Ouachita; (highest point, Magazine Mountain, 2,785 feet). Chief rivers: Mississippi, St. Francis, White, Arkansas, Red, Ouachita. Hot mineral springs in center of State.

Chief Products.—Cotton and cotton products (oil, cottonseed, oil cake); corn, rice and other cereals, hay, fruit; lumber and timber products; coal, bauxite, lead, zinc.

Chief Cities.—Little Rock (capital, 65,000 population), Fort Smith, Pine Bluff, Hot Springs.

water a minute. At Hot Springs, about 45 miles southwest of the capital, Little Rock, the United States government has taken over an area of 911 acres in which are located nearly 50 springs.

The reputation of this famous health resort is equal to that of many of the great *spas* of Europe. The springs are said to owe their curative properties to the presence of a radium emanation or radium gas in the water. It is estimated that 125,000 people, or about twice the entire population of Little Rock, visit the springs every year. Some writers think that it was the rumors of these springs circulated among the Indians, which set the Spanish explorer Ponce de Leon on his search for the fabled Fountain of Youth.

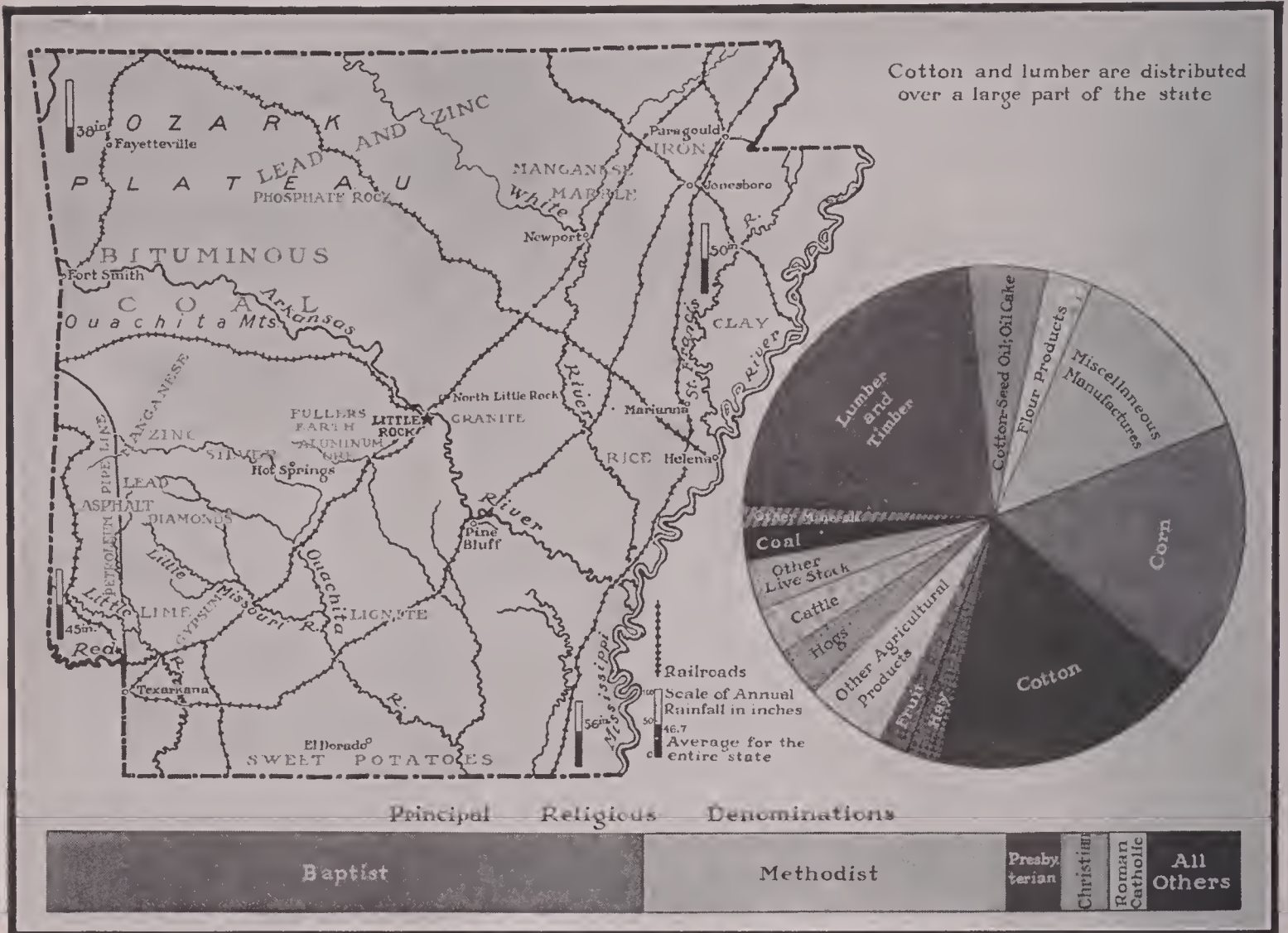
Although the state is comparatively old there are still many vast unexplored caves, especially in the region of the Ozark Mountains in the northwestern part. The highest peak in the state is less than 2,800 feet. In the east and south the land rises very little above the level of the Mississippi River, which makes the eastern boundary of the state and often overflows its banks, causing swamps and marshes. Arkansas is very nearly square in form.

Little Rock, the capital of the state, had 196 white inhabitants as long ago as 1785. It was named "La Petite Roche" (the little rock) by Sieur Bernard de la Harpe, in 1722, who visited the region in search of a mythical emerald mountain. Texarkana, the second largest city, is, as its name indicates, on the border between Arkansas and Texas, part lying in each state.

The state has four agricultural colleges, and a Farmers' Institute in the capital which has conducted some important agricultural movements. The state university is located at Fayetteville, on the Ozark plateau in the extreme northwestern part of the state. Separate schools are provided for whites and negroes. The "Bear State," as Arkansas is nicknamed, has *Regnant populi* ("the people rule") for its motto.

The name Arkansas was that of an Indian tribe found by the first explorers of the region, who were mostly French. The first white settlement was made at Arkansas Post in 1685. The country was a part of Louisiana Territory until 1812, when it was included in the newly formed Missouri Territory. It was not formally organized as a state until June 15, 1836.

ARKANSAS AND ITS VARIED PRODUCTS



From the circular diagram you see at a glance the relative importance of the varied products of Arkansas, and on the map the location of its natural resources. Fix the circle and its divisions in your mind and you are not likely to forget in your geography class that lumber and timber are nearly a fourth in amount of the total product of the state, while the cotton and corn interests are only a little less extensive and about equal to each other. To the value of the cotton we must add about one-fifth for the value of cotton-seed oil and oil cake.

At the time of the Civil War it was not clear at first whether the Unionists or the Secessionists were in the majority. Finally Arkansas cast in its lot with the Confederate States. Little Rock was taken by the Union Army in 1863 and this event ended the Secessionist reign in Arkansas. The Unionists called a convention in Little Rock in 1864 and formed a new constitution, which, however, the United States Senate refused to accept. It was not until June 22, 1868, that Arkansas was readmitted to the Union. Like other southern states, Arkansas suffered much from the evils of the "carpet-bag" era in the interim.

Arkansas is one of the states which has the initiative and referendum. By this method the people can put a law on the statute book regardless of the action of the state legislature. When the legislature refused to pass a bill against child labor, by using the initiative and referendum the people made it a part of the state law.

ARKWRIGHT, RICHARD (1732-1792). On a stormy night in the year 1765, a foot traveler knocked at the door of a thatched cottage in a little village of Lancashire, England, seeking shelter. The light of a candle

and the whirring of a wheel guided him to that dwelling rather than to any other of the group. A cotton-spinner was there lengthening his day of toil, while his neighbors slept. At his knock the candle was blown out and the noise stopped. After a moment a voice asked:

"Who knocks?"

"Dick Arkwright."

"A spinner?"

"No, a barber and hair buyer from Bolton. I can pay for a lodging for the night."

When the stranger was admitted and the candle relighted, there was disclosed a strange spinning apparatus with eight spindles. The host was James Hargreaves and this was his newly invented spinning jenny, which he used secretly because of fear of jealous rivals. The traveler was Richard Arkwright, who was to become the inventor of the spinning frame. At this time Arkwright was 33 years old. He was born in Preston, a seaport town north of Liverpool, and was the youngest of 13 children of a poor laborer. At the age of 10 he was apprenticed to a barber in Bolton, and for 20 years his life was passed in a cellar shop, shaving workmen at a penny a shave.

SOME OF THE THINGS FOR WHICH ARKANSAS IS FAMOUS



Corn and Cotton—Chief Sources of Wealth

Innense Forests and Sawmills

Arkansas

The Rest of the World

Half of the World's Aluminum Supply

Great Ostrich Farms

Largest Diamond Field in North America

America's Leading Mineral Spring State

Peabody Hall, University of Arkansas

The Beautiful State Capitol—Little Rock

Vast Deposits of Whetstone Rock

Crops of both North and South

So great is the variety of her natural resources that Arkansas may be called a little world in itself. The chief sources of her agricultural wealth are corn and cotton, but she produces in rich abundance many varieties of fruit, vegetable, and grain peculiar to both northern and southern climates. She has immense forests and an extensive milling industry to work them up into lumber, vast deposits of whetstone rock, great ostrich farms, the largest diamond field in North America, and it is highly probable that the aluminum in mother's kitchen utensils was "born" in Arkansas.

contained in the Easy Reference Fact-Index at the end of this work

It is doubtful if he could then read and write, but he "had notions in his head." He became a hair buyer and wigmaker, and it was in the course of his business that he found himself at Hargreaves' door.



R. ARKWRIGHT
Inventor of the Spinning Frame

Hargreaves' jenny could spin eight threads at once, but the yarn was still inferior. Arkwright set to work to invent a new machine which should spin a much larger number of threads, of any degree of fineness and hardness. He took out his first patent in 1769. His spinning frame consisted of two sets of rollers turning on each other like those of a clothes wringer. One roller of each pair was of steel, finely grooved, the other was covered with leather. The fibers of the cotton plant were drawn through the grooves, compressed, and stretched. Spindles then took the yarn and twisted it. His first spinning mill, at Nottingham, was worked by horses. Later he used water power, and finally the improved steam engine which James Watt was just then inventing.

Arkwright's wonderful invention inspired the jealousy of rivals. His patents were attacked and declared void, and his spinning frame was copied with impunity. However, they "couldn't copy his mind," and by further improvements and good business management he won a comfortable fortune.

Arkwright's executive ability is shown by his part in organizing the factory system. Before Arkwright's time spinning was a cottage industry, and much of the

weaving was also done in private houses. The workmen labored irregularly, and the product was far from uniform in quality. Arkwright brought his

workmen under a factory roof, compelled cleanliness, order, and regularity of hours, and established standards in quality and quantity of fabrics produced. He put into practice the principles of industrial economy that Adam Smith taught—the saving accomplished by organized, disciplined division of labor.

After he was 50 years old Arkwright educated himself to fit his new station in life. In 1787 he was knighted by King George III. Thenceforth he was known as Sir Richard Arkwright. He died in his 61st year, having done much to lay the foundations of the industrial prosperity of Great Britain, and to usher in a new industrial age for the civilized world.

ARMADA, SPANISH (1588). Bonfires were blazing all along the Channel coast of England, and their flames shooting high in the air carried the news from hilltop to hilltop through the greater part of England that the Great Armada was at hand. This was an enormous fleet which Catholic Philip II of Spain had gathered to conquer Protestant England. Its sailing had been delayed a full year by the daring feat of Sir Francis Drake who had sailed boldly into the Spanish harbor of Cadiz and destroyed the ships and

SIR FRANCIS DRAKE FINISHING THE GAME OF BOWLS



"There's plenty of time to win this game and thrash the Spaniards too." Can't you hear him saying it? Drake, with the bowl in his hand, calmly refuses to listen to Lord Howard's suggestion that they put to sea at once. The English preparations had been so well made that now, when the Armada was at hand, Drake knew that they had nothing to do but wait for the propitious hour to arrive to give battle.

supplies there, thus "singeing the Spanish King's beard." But now at last about 132 Spanish vessels were ready, some of them huge high-decked men-of-

war, some of them strange old galleys rowed by oars, and were sailing up the English Channel in a great half-moon seven miles from tip to tip, to conquer that heretic land and restore it to the true Catholic faith.

When word of the Armada's approach had first been brought to the commander of the English fleet, Lord Howard of Effingham, he chanced to be ashore at Plymouth—so the old story tells us—playing at bowls with some of his captains. Lord Howard was for putting to sea at once, but doughty Sir Francis Drake calmly remarked:

"There's plenty of time to win this game, and to thrash the Spaniards too."

The "Little Hawks" Pluck the Spaniards

So the game went on. Next day the English ships poured out of the Channel ports in pursuit of the Spaniards. They were smaller than the ponderous vessels of the Spaniards, but they could sail two feet for the Spaniards' one. For a week they hung on the rear of the foe, now advancing, now nimbly retiring, and "plucking the feathers" of the Invincible Armada one by one.

When at last the Spaniards anchored off Calais, there to get word of the army that was to join them from the Netherlands, the Englishmen sent fire-ships drifting down on them at midnight. In panic the Spaniards cut their anchor cables and put out to sea.

At dawn the little English "sea hawks" closed in again and worked terrible havoc, crowding the clumsy galleons upon one another, sending some to the bottom, and killing thousands of men with their deadly cannon fire. The Spaniards lost hope of success and thought only of escape.

But worse still was to come. As they fled before a southerly wind, meaning to return to Spain by sailing around the north of Scotland and Ireland, terrific gales beat upon them and dashed many of their vessels on those rocky coasts. The bodies of thousands of drowned Spaniards were washed ashore, and others were killed by the lawless inhabitants when they floated or swam to land. Of all that great fleet, less than half returned to Spain.

Thus English courage and seamanship had delivered that land from one of the greatest dangers that ever menaced it. Though they were vastly inferior in equipment—for niggardly Queen Elizabeth had turned a deaf ear to urgent appeals for powder and other supplies—the daring English seamen had broken Spanish sea power for all time. The way was at last open for England to lay the foundations of the trade, colonial empire, and sea power which make her today the "mistress of the seas."

ARMADIL'LO. Did you ever see a pig-like animal that wears armor? The armadillo of Central and South America is such a creature, for the whole back and sides of his body are covered with jointed bony plates like the mail worn by medieval knights. In

addition some species are so constructed that when danger threatens they roll themselves up into tight round balls, with head and feet tucked in and nothing showing but the thick hard plates of their armored backs. Even a jaguar has difficulty in knowing what to do with such a living cannon ball.

The armadillo has very short legs, but it can run with considerable speed for short distances. It can also bury itself in an incredibly short time by the use of its long powerful claws. The great armadillo has a body three feet long and a tail almost as long,

THE ARMADILLO IN ITS FLEXIBLE
COAT OF MAIL



Armadillos are like the knights of the Middle Ages in the matter of dressing in "hardware," but they don't go about looking for trouble as the knights did. They are of a very peaceable disposition. The great naturalist Darwin tells how one of the South American cowboys sharpened his knife on the horny back of one of them, and Mr. Armadillo didn't object in the least!

while others are only five or six inches. Fossil forms six feet in length have been found, looking much like giant turtles.

In color armadillos are usually brownish-black, marked with yellow above and yellowish-white underneath. They are habitual diggers, making their burrows in the dry soil of arid regions. Some species are found as far north as Texas and others as far south as Argentina. Armadillos fare forth chiefly at night to seek their food which consists of insects, worms, roots, fruit, and sometimes carrion. The natives use their flesh for food and make their bony backs into handsome baskets.

Armadillos are members of a group of toothless or almost toothless animals which includes the ant-eaters. Scientific name of great armadillo, *Priodon gigas*; of the apar (one that rolls into a ball), *Tolypeutes tricinctus*.

ARMENIA (är-mē'nĭ-ă). One day late in the 3d century of the Christian era, a beautiful Roman maiden Ripsimé was brought into the palace of Tiridates, king of the Armenians. She had fled from Rome, according to the story, to escape the emperor Diocletian who had sought to marry her, though she was a Christian and a nun. Tiridates, struck by her great beauty, also sought to make her

his wife, but she refused, saying she would not give up her faith or break her vows by marrying a heathen king; and when Tiridates attempted to use force

he went out into the fields and ate herbs. And it was not until he had ordered the release of Gregory the Illuminator, a Christian missionary whom he

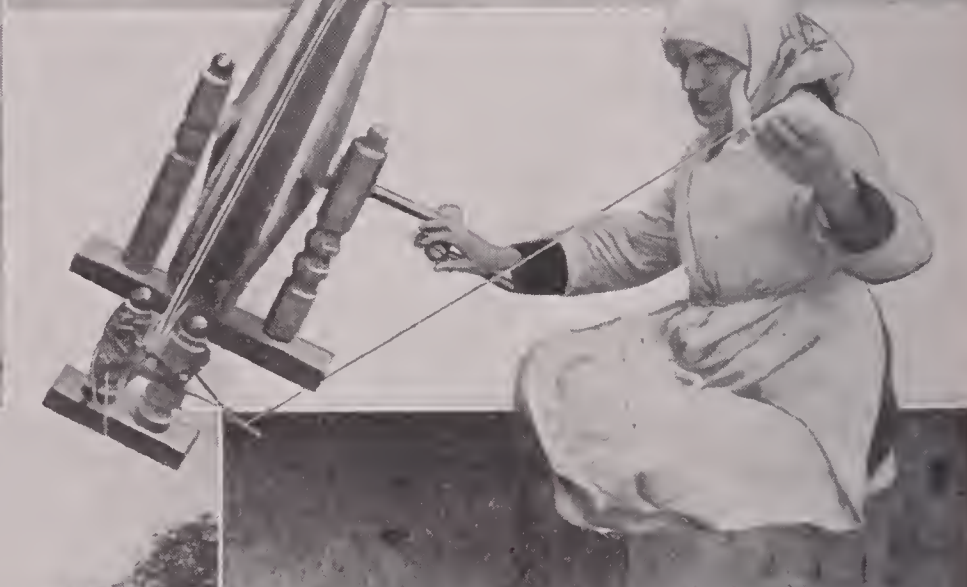
IN THE LAND OF THE ARMENIANS



Armenian Girl



"Parking" Place for Ox Carts



Spinning within Protecting Walls



Figs Going to Market

The pretty Armenian girl in the upper left-hand corner of this group is a type of thousands who were sold into slavery while Armenia was under Turkish rule. The ox-carts on the right have been left there by the peasants who have come to town and are marketing in the neighboring street. The woman at work in the center shows the type of spinning wheel and style of spinning which has been employed in Armenia for centuries. Below are women spinning in the basement of a massive stone house—almost a fortress—such as are common in Armenia as refuges from Turkish attacks. On the left are peasants with their donkeys loaded with figs on the way to market. Although Armenia is a high plateau, the summers are so hot that semi-tropical fruits are cultivated in the deeper valleys.

she threw him to the floor and broke his diadem in pieces.

In his anger he caused Ripsimé and her companions to be put to death. Soon afterwards Tiridates was seized with remorse; and like Nebuchadnezzar

had thrown into prison 15 years before, that he was restored to sanity. St. Gregory brought about his conversion, and thereupon Tiridates decreed that Christianity should thenceforth be the official religion of the Armenian people.

This story is preserved in the ancient religious writings of Armenia, and if you should visit the convent of Etchmiadzin, where the *Catholicos* or head of the Armenian church has his residence, you will find a church dedicated to the memory of St. Ripsimé. From Etchmiadzin it is not a long journey across the plain to snow-capped Mt. Ararat, on which according to tradition Noah's ark finally found a resting place.

When the patriotic Armenian, before the World War, visited the shrines on the slopes of Ararat, he was constantly reminded of the misfortunes that had come upon his nation. If he looked to the north-east he saw that part of ancient Armenia which was conquered by Russia. If he looked to the west he saw another part that was long held by Turkey. And if he looked to the south he saw still a third part which was taken by Persia. Thus ancient Armenia was all divided up among other states and the Armenians had no country they could call their very own.

Armenia lies in Asia south of the Caucasus Mountains, between the Black Sea and the Caspian at the base of the peninsula of Asia Minor. To the south lies Mesopotamia, the fertile valley of the Tigris and the Euphrates rivers. Armenia itself is a high plateau which might be compared to North Dakota both in size and climate. The winters are very cold and the summers are very hot. The oriental sun touches the scenery with brilliance and turns the sky and lakes to sapphire, but the land itself seems barren and untidy. Yet rivers are numerous and

Armenians have reached a high stage of culture and education.

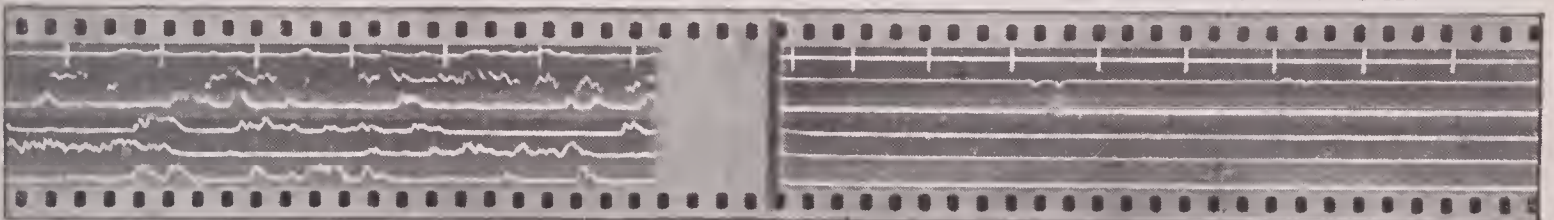
The tragic fate of the Armenians under Turkish rule culminated during the World War, when perhaps 600,000 were massacred or done to death by the Turks with the knowledge if not the approval of their German allies.

Armenia has been the home of the Armenian people since prehistoric times. It appears as a kingdom in Assyrian inscriptions under the name of Urartu. It formed part of the old Persian Empire and was brought under the rule first of Alexander the Great and then of the Romans. Legend traces the descent of its people from Haik, son of Togarmah, great-grandson of Noah. Estimates of the Armenian population are very uncertain; before the war there were probably 3,000,000 in Turkey, Russia, and Persia. The area of the Armenian plateau is about 140,000 square miles.

After the defeat of Turkey in the World War, the people of Turkish Armenia set up an independent republic. It was their desire to have the United States undertake a mandate for Armenia until the country could stand on its feet, but this wish was not fulfilled. (For map see Asia.)

AR'MISTICE. One minute before eleven o'clock in the morning of Nov. 11, 1918, the long battle front still shook with the deafening roar of great cannon, the hum of countless rifle bullets, and the rattling *put-put-put* of thousands of machine guns. One minute after that hour a stillness almost of death brooded over the scene, and here and there could be heard the faint happy song of little birds. The armistice with Germany, which had been signed early that morning, had gone into effect.

WHEN THE GUNS OF THE WORLD WAR CEASED TO ROAR



These may be said to be the autographs of big guns recording the end of the World War on Nov. 11, 1918. They were "written" on an instrument which records the vibrations produced by guns and so enables experts to determine both their location and caliber. The jagged lines on the left show the almost incessant firing which continued up to the very minute the armistice took effect. The straight lines on the right show how unbroken stillness suddenly followed, except for the two small explosions recorded in the second line.

in their valleys a great many crops are cultivated. There are also some famous gardens, especially near Lake Van, the largest body of water in Armenia.

In modern Armenia there are few railroads and you travel mostly on horseback. An armed escort is often necessary, especially in those localities inhabited by the picturesque half-civilized people called the Kurds, who often make their living by robbing caravans. On the other hand the traveler has little to fear from the Armenians themselves, though their merchants are shrewd bargainers. It has been said that "it takes a Jew to get the better of a Turk, a Greek to outwit a Jew, and an Armenian to beat a Greek." The Armenian peasants are often fine stalwart-looking people of distinctively oriental appearance, but we of America would probably think they were dirty and primitive in their habits. In the towns such as Erivan and Erzerum, many

An armistice differs from a truce in that it extends to the whole or a considerable part of the armies of two or more countries, and precedes or looks toward negotiations for peace. Advances, retreats, or the redistribution of troops in the fighting line are forbidden during an armistice, but supplies and reinforcements may be brought up. It was an armistice of this sort that was concluded between the Central Powers on the one side and Russia on the other on Dec. 15, 1917.

The armistices which were concluded between the victorious Allies on the one side and defeated Bulgaria (Sept. 29), Turkey (Oct. 31), Austria-Hungary (Nov. 3), and Germany (Nov. 11, 1918) were of a different sort. They contained such severe terms that, instead of maintaining the existing military situation (*status quo*), they were deliberately framed so as to make it impossible for the Central Powers

to resume the war. They amounted, therefore, to surrender on the part of Germany and her allies and forecast the peace terms to be imposed on the defeated states. (See World War of 1914-18.)

ARMOR. From earliest dawn the camp was alive with the neighing of horses and the running to and fro of pages and squires; and from the tents came sharp exclamations, sounds of hammering, the clank of armor being donned, and the rattle of swords and shields. For this day, please God, the little army of the Black Prince of England should face and conquer

the vast hosts of the French king in the battle of Poitiers.

In the tent of the commander the last council of the captains had been held and the Prince himself was being arrayed for battle. Over his head was drawn the shirt of chain-mail, reinforced with breastplate and backplate and shoulder- and arm-guards of bur-



Visor or helmet worn by snipers and machine gunners in the World War.

nished steel plates. Next he donned waist-piece and loin-guard, and thigh-pieces, knee-guards, greaves, and shoes of jointed mail—the whole an ingeniously fitted combination of chain-mail and steel plates. Then the great visored helmet was placed over his head, with a coil of flexible mail to protect the neck; and iron gauntlets were drawn upon his hands.

Piece by piece the jointed plates were adjusted to shoulder, elbow, hip, knee, and instep, so as to permit of the greatest freedom of motion possible; and all was securely made fast with buckles, locks, and rivets. Over all was drawn a jupon or sleeveless tunic of cloth, emblazoned with the heraldic insignia of the Black Prince. Lastly the trusty sword was girt about the Prince's waist, on his left arm he took his shield, and he was ready to sally forth.

The Long Story of Armor

Such armor as this was the result of centuries of progress in warfare. Except in the remotest times and places, when hides were used, ancient armor was made of metal, usually brass or bronze, though not infrequently wood or leather was used for particular purposes. The earliest armor consisted of only a shield, to ward off blows from club, ax, sling-stone, javelin, sword, or arrow—such as the shields of the ancient Egyptians, Assyrians, Etruscans, Greeks, and Romans.

As the need for greater protection was felt, the helmet, a device which at first resembled our modern football player's head-guard, was adopted. Then came the breastplate, and then greaves or sheaths of metal or other material for the legs from knee to ankle, somewhat like the football player's shin-guards.

Eventually the desire arose to protect the whole body, and so small bits or plates of metal, or of metal rings, were sewn closely together upon a tunic of leather or stout cloth, and worn to supplement other

defenses. Thus we find the Greeks and Romans equipped not only with shields, helmets, breastplates, and greaves, but also with a short kilt of cloth or leather covered with metallic rings or other bits of metal.

A similar garment, which hung from neck to knee and eventually acquired sleeves—known as a “coat-of-fence” or “hauberk”—was worn by the followers of Duke William at the time of the Norman conquest. They also wore an iron cap or helmet with a “nasal” or nose-piece like our gridiron hero's nose-guard. From that time on knights were rarely found unmounted, and the cavalry (which was originally the same word as “chivalry”) became the only honorable arm of service. Other troops were held almost in contempt.

As time went on the bits of metal were sewn closer and closer together, until they overlapped like the scales of a fish, so giving rise to “scale armor.”

Not infrequently, the rings were all interlinked or woven together, like the chain-mesh purses that women sometimes carry today. This “chain mail” was often to be seen at the time of the Crusaders, and until the 14th century.

Bit by bit, meanwhile, the coat of mail was reinforced with plates of wrought iron or steel to protect special parts of the body—the breast and back, the shoulders, arms, legs, and the like. For 200 years this gradual change went on. By the end of the Middle Ages we find in western Europe complete suits of plate armor of great beauty and perfection of workmanship, such as are shown in the accompanying illustrations.

A Suit that Weighed 70 Pounds!

A complete suit of this plate armor was worth a king's ransom, and none but princes and great nobles could afford them. They were very heavy, weighing 70 pounds or more, so that the wearer must be lifted into the saddle by his squires or men-at-arms. The sturdy horses also were elaborately protected by similar suits of armor.

It was armor of this sort that James I of England had in mind when he said that he was “in favor of warriors wearing armor, for it not only protected them from injury but also prevented them from injuring others!”

Such complete equipment of knight and horse in plate armor was mainly used in tournaments and joustings. Already the English longbow and the crossbow, and the spear-like pikes of the Swiss, even before the coming of the arquebus and other forms of hand firearms, had put the armored knight at a disadvantage on the actual field of battle. But the breastplate or cuirass, and other forms of half-armor, continued in use until the beginning of the 18th century.

Then the new strategy calling for long marches and the extended use of gunpowder in warfare made all sorts of armor for a time impracticable. In the World War of 1914-18, however, the new conditions

TWENTY CENTURIES OF MEN IN ARMOR

Greek
Hoplite
4th Century B.C.

Norman
Warrior
11th Century

Roman
Legionary
1st Century B.C.

English
Knight
12th Century

Duke William's Normans who conquered England were only a little more advanced in armor. The "hauberk" or "byrnie" might be of metal rings sewed on leather or cloth, or of overlapping scales as shown here. Often the lower part was like short trousers. In the next century the hauberk was longer, and of interwoven metal rings or small overlapping scales, covering the neck and terminating in a steel cap or "basinet." A heavy "pot"-helmet was usually added when knight charged on horseback with lowered lances.

The two mounted figures show the knight with his indispensable steed, in later days fully armored like his master. Plate defenses for the shoulders, upper arms, elbows, breast, knees, shins, and feet were common by the 14th century, when England's long-bowmen defeated the chivalry of France at Crécy and Poitiers. Such full plate armor as that shown for the 16th century was used chiefly in tournaments.

Full Plate
Armor
16th Century

Chain
Mail
14th Century

If the warriors whose bones have so long since gone back to the dust could revisit the earth, clad as they were in life, they would look much as you see them here. This picture-story begins with the Greek "hoplite" who defeated the Persians, and whose descendants, under Alexander, overran all Asia. Then follows the Roman, who "shortened his sword in order that he might enlarge his boundaries," preferring to fight at close quarters. Then, after a period of a thousand years, we see the Norman man-at-arms, with his "football nose piece"; next the mail-clad knight on foot; after that the mounted warrior of the 14th century in half-plate armor, and finally the knight in full plate armor, mounted on his armored steed. No wonder their squires had to hoist them into the saddle!

contained in the Easy Reference Fact-Index at the end of this work

of trench warfare led to a revival of light steel helmets in all the armies.

The practice of wearing heraldic figures on shield and surcoat became necessary as a means of identifying the wearer when his face and body were so completely covered with armor (see Heraldry).

ARMOR-PLATE. When steam-power made it possible to build ships of immense size, the idea of armor was revived and applied to the protection of big battle craft. The first experimental use was by France, in 1855, when three armored "floating batteries" were sent against the Russians with great success in the Crimean War. The battle of the *Monitor* and the *Merrimac* was the first demonstration of armored ships in actual combat (see *Monitor* and *Merrimac*).

At first armor-plate was of wrought iron. As the power of guns increased, improved armor was devised, and so the race has continued between the resisting power of armor-plate and the armor-piercing shot and shell. Today nickel steel with a small admixture of chromium is used, and the hydraulically

forged plates are specially hardened by a process which makes the outside intensely hard, while the interior is left very tough and non-cracking. Even so, in close-up fighting, the high velocity armor-piercing cannon shot, when a square hit is scored, bore through such armor like a bullet through a pine board.

The largest battleships now carry a belt of armor steel extending five feet below the water-line. It is from 12 to 18 inches thick in the middle of the ship, but grows thinner toward bow and stern. Walls of steel extend also from side to side across the body of the ship, so that the central section becomes an armored box, within which the crew, the machinery, and the powder magazines are protected. The gun turrets are surrounded with the heaviest plates, and thinner sheets are spread over the deck itself.

Armor-plate of less thickness is used for gun-shields and in the turrets of some land fortifications. It is also used for armored railway trains in war time, and for armored automobiles, such as the "tanks" used in the World War.

How NATIONS ARE ORGANIZED for WAR

ARMY. If it were possible to collect in one vast field all the millions of men in a modern army—infantry, cavalry, artillery, air service, and services of supply—with all their weapons from the automatic pistols to the giant siege howitzers, and with all their equipment from the individual soldier's pack to the great trains of supply trucks and motor cars—that field would still represent only a fraction of the strength of a modern nation at war.

Where armies are counted by the millions, warfare becomes the vastest and most complicated of human activities. For every man in the actual fighting line there must be two or three behind the lines to bring up supplies, keep up communications, and perform similar duties—to say nothing of the vast army of workers at home in factory, mine, and field.

Most Important Part of an Army

Of the combat troops, the infantry (foot soldiers) remains—as it has been ever since the knight in armor went down before the bows and pikes of the foot-soldiers of the 14th century—the most important and most numerous arm. As an American general puts it, "the infantry is the army." It must bear the heaviest burdens and losses in the field of battle and on the march. Its effectiveness has been enormously increased by the modern automatic rifle and machine gun.

THE modern army is, in a sense, the entire nation.

For today it is not alone the actual fighting force that enters into the making of war. Modern warfare, with its enormous hosts in arms, has become so gigantic a business that every person in the land is vitally concerned, and is expected to "do his bit" toward achieving victory. The farmer, the miner, the mechanic, the clerk, the stenographer—each must give of his or her best to provide the fighting men at the front with the sinews of war, and to keep the strength of the nation at its highest possible pitch. Here we have a brief sketch of the history and development of armies, together with some account of their chief divisions and the terrible weapons of destruction which an army today employs.

The cavalry (mounted troops) is of less importance under the conditions of modern warfare between highly trained and fully equipped armies, especially during trench warfare and siege warfare. In the open warfare necessarily preceding and usually following such operations, cavalry is invaluable because of its extreme

mobility, as a screening force, a pursuing force, and a scouting force.

The aviation service, with its captive balloons and its airplanes, supplements the cavalry as a scouting force. Airplanes—sometimes called "the cavalry of the air"—are also an important fighting arm, being used for bombing, for offense and defense against other planes, and even for attacking troops on the ground with machine-gun fire.

Supporting the infantry and covering its movements, whether advancing or retreating, is the field artillery, which must be distinguished from the coast artillery of the United States army. The latter is used, as its name indicates, only for protection of sea-coasts, and it consists of the heaviest possible armament, most of it permanently fixed on concrete emplacements. There are two divisions of field artillery—light and heavy. The light artillery is armed with 3-inch guns; the heavy artillery is armed with guns above 3-inch caliber including 6-inch guns

and howitzers. In addition armies sometimes include horse artillery in which the cannoneers are mounted on horseback, and mountain artillery, in which light guns are carried on mule or horseback for operation in difficult country. In the World War of 1914-18 the Germans used siege artillery, consisting of howitzers and mortars of great size, to reduce fortified towns; and also special long-distance guns—one type shooting 70 miles. The Americans replied by mounting 13-inch naval guns on mobile railway carriages. The importance of the artillery arm has been vastly increased with the development of trench warfare and the necessity of destroying dugouts, machine-gun "pill-boxes," and barbed wire entanglements before the infantry can advance. "The artillery destroys, the infantry occupies," is a modern maxim which expresses the situation.

The Artillery and the Tanks

To supplement the work of the artillery and make it possible to deliver surprise attacks without the necessity of a heavy preliminary bombardment, a new arm came into existence during the World War of 1914-18—the Tank Service. This service has been called "the charging artillery," since its armored "caterpillar" cars—some of them great lumbering affairs and others small rapid-moving "whippet" tanks—carrying machine guns and even 3-inch cannon, can plunge across wire entanglements, trenches, and very rough ground, and penetrate far into an enemy's position.

No less important, and often no less hazardous, than the work of these combat troops is that of the various auxiliary services. To the Engineer Corps falls the duty of laying out and constructing trenches, mines, roads, bridges, and railroads in the combat area. Much of this work must be done at the front under shell fire and the units assigned to such duty are usually called "sappers." The Signal Corps is the agency by which a commanding general keeps in communication with the units of his army. It builds and operates telegraph, telephone, and radio apparatus, and is also in charge of all other signaling methods, such as the pigeon service and the motorcycle service.

To keep the fighting troops supplied with all the

necessary equipment there must be various services of supply. The Quartermaster Corps looks after the soldier's material welfare, providing clothing, shelter, food, transportation, and pay. One of its important branches is the motor transport corps, which fills the roads behind the lines with an inconceivable mass of

auto trucks carrying ammunition, food, and reserves to the front and bringing back the wounded. The Ordnance Department furnishes the soldier with his fighting equipment—cannon, small arms, ammunition, etc. When you remember that as much ammunition is sometimes fired in a single day of a modern battle as in the whole Boer War, you get some idea of the tremendous demands on this department. An-

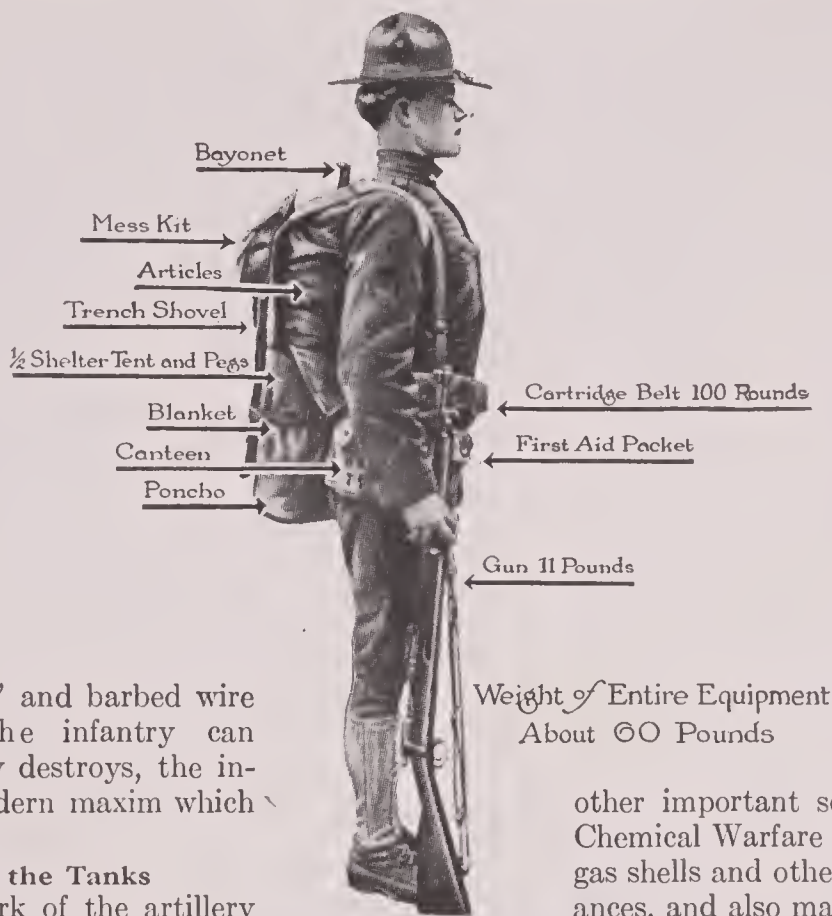
other important service of supply is the Chemical Warfare Service, which provides gas shells and other gas-distributing appliances, and also masks and other defensive equipment against the enemy's poison gases.

But the modern army is not only engaged in inflicting wounds; it must also heal them and restore as many of its casualties as possible to the ranks, either of fighting men or citizen workers. In addition it must safeguard the health and morale of its troops by preventing and fighting disease. These important duties fall to the Medical Department, with its various branches such as the Medical Corps (surgeons and doctors), the Dental Corps, Veterinary Corps, Nurse Corps, and Ambulance Corps. The division of physical reconstruction supplements the regular hospital work by giving disabled fighters such treatment as will enable them to overcome their handicaps as fully as possible.

In addition to these services there are chaplains to look after the moral and spiritual welfare of the men; musicians, who act as stretcher-bearers at the front; and a host of skilled workers, such as cooks, blacksmiths, auto-mechanics, saddlers, tailors, barbers, etc.

The commander-in-chief of the United States Army is the President. The administration is carried on by the War Department under the direction of the Secretary of War. The General Staff Corps, under the chief of staff, prepares plans for national defense

THE EQUIPMENT OF THE UNITED STATES SOLDIER



and has general supervision of questions affecting the efficiency of the army as a whole. The Adjutant General's department keeps all records and has charge of official literature, correspondence, etc. The Inspector General's department exercises general supervision over such matters as condition of uniforms and equipment and expenditure of public money. The Judge Advocate's department is the legal branch of the army and supervises courts martial, etc.

Origin of Modern Army

The modern army, as distinguished from the levies of feudal times based on the principle of personal allegiance, and from the civic militia of the cities of the Middle Ages, may be said to date from the time of Gustavus Adolphus. During the Thirty Years' War (1618-48) he originated the modern army of professional or mercenary soldiers, developing the idea from the bands of *condottieri* in Italy who used to sell their services to the highest bidder. His example was soon followed by Louis XIV of France and most of the other crowned heads of Europe. This type of army was developed to its highest efficiency by Frederick the Great in the following century, and with it he started Prussia on that career of conquest which ended in her downfall in the World War of 1914-18.

The greatest revolution in the history of modern warfare, however, was brought about in 1791, when France revived the principle of universal service or conscription which had been used by some of the ancient nations, notably Sparta and Rome. It was the adoption of this principle by Prussia that gave it the magnificent military organization which it used tyrannically to defeat in succession within the space of six years, Denmark, Austria, and France, and finally to make its disastrous attempt to seize world supremacy.

Prussia took this momentous step to evade the consequences of the rigorous terms imposed on it by Napoleon after its defeat at the battle of Jena in 1806. Forbidden to maintain more than a small standing army, Prussia adopted the expedient of calling in successive groups its able-bodied young men to the colors for a brief period of training, and then passing them on to the reserve and filling their places with the next class of recruits. The Prussian army was thus turned into a vast training school, whereby the whole male population was disciplined and made ready for war.

To meet the menace created by this formidable fighting machine, one European country after another was forced to adopt the same system. At the outbreak of the World War Great Britain and the United

States were the only powers of importance that still depended on the old system of small standing armies of professional soldiers, to be supplemented by volunteers in case of war; and when they entered the conflict, both these nations adopted conscription.

Switzerland practices a modified form of conscription which gives her one of the best citizen armies of the world. There is no standing army, but all able-bodied males are enrolled in the militia and compelled to undergo training for a few weeks each year, until they pass into the reserves.

How Armies are Made Up

An army, as the accompanying table shows, is made up of units within a unit, so that it can readily be separated for any purpose into any number of parts. Each of the three arms of the

TABLE SHOWING INFANTRY ORGANIZATION IN THE UNITED STATES ARMY		
Unit	Commanded by	Includes (among Other Troops)
Army.....	General.....	2 or more army corps
Army corps.	Lieut.-Gen.....	2 or more divisions
Division....	Maj.-Gen.....	2 brigades
Brigade.....	Brig.-Gen.....	2 regiments
Regiment...	Colonel, assisted by Lieut.-Col.....	3 battalions
Battalion...	Major.....	4 companies
Company...	Captain.....	4 platoons
Platoon.....	1st and 2d Lieuts...	4 squads

service has a different organization. The table gives the infantry organization only, and is designed merely to show the thread of army organization. The "other troops" in an infantry division besides the two brigades include such units as one regiment of engineers, one sanitary train, one division headquarters, etc., constituting more than one-third of the total strength of a division.

The number of men in the various units varies with different armies. In the United States Army an infantry company consists of 256 officers and men, a regiment of 3,755, and a division of 27,150. Platoons are subdivided into squads, commanded by sergeants and corporals, who receive their appointments from within the unit to which they are attached and are therefore called "non-commissioned" officers as distinguished from "commissioned" officers, who receive their commissions from the government.

ARMY-WORM. Did you ever see a whole army of worms on the march, sweeping across fields and destroying every stalk of grain and blade of grass in its devastating advance?

The so-called "army-worm" is such an insect pest, and they are sometimes so numerous that the sound of their eating can be distinctly heard. The "worms" are the larvae or caterpillars of a moth which is closely allied to the one which produces the cutworms. The moths are of a dull brown color, with a prominent white spot in the center of each front wing. The full-grown larvae are about 1½ inches in length and are striped with black, green, and yellow. This pest appears every year east of the Rocky Mountains, but is usually checked before it does serious damage. The tachina fly destroys incalculable numbers as also do fungous diseases.

When a field is attacked the crop should be burned or plowed in. Hordes on the march can be destroyed

by plowing a narrow strip in their path and constantly harrowing and rolling it to crush the caterpillars.

Scientific name of army-worm moth, *Heliophila unipuncta*; family, *Noctuidae*. Certain species of ants and grasshoppers also advance in great armies and do untold damage at times; and even some butterflies sometimes migrate in such dense clouds as to be a decided nuisance.

AT THE FRONT WITH THE ARMY-WORM

A NIGHT RAID FROM THE AIR

AN ILL WIND THAT BLOWS NOBODY GOOD



INFANTRY ON THE MARCH

OUR REINFORCEMENTS TO THE RESCUE



The picture in this group which shows these many-legged infantrymen on the march tells you how the army-worm got his name, marching in rank from field to field. Of these worm armies, still more than of human armies, Napoleon might have uttered that famous saying, "an army travels on its stomach." Follow the pictures through in order, and you will carry away a pretty complete story of one of the many enemies against which the farmer must defend his fields.

ARNOLD, BENEDICT (1741-1801). The name of Benedict Arnold has become a synonym for treason to one's country. But in the early days of the American Revolution there were few generals so brilliant and dashing, and few who, in spite of a certain recklessness of character and fondness for excitement, were so well thought of on the patriot side.

When 15 years old he ran away from home and joined the American forces in the French and Indian War, but he soon repented and returned home. On the outbreak of the Revolutionary War he helped Ethan Allen and his Green Mountain Boys to capture Fort Ticonderoga. Then he took a gallant part in the disastrous siege of Quebec, where he was wounded and for his bravery was made a brigadier-general. Later he handled with skill a flotilla in battle on Lake Champlain.

Arnold had a violent temper and when, in 1777, five of his inferiors in rank were made major-generals, he was very angry. But he yielded to Washington's persuasions to keep on fighting in the colonial cause. He showed his usual skill and bravery in the battle of Ridgefield, where his conduct gained him the rank of major-general, and in the battle of Saratoga, where his horse was killed under him and he himself was severely wounded. Disabled by his wound, he spent much of the winter of 1777-78 in a hospital in Albany, and the next spring was placed in command of Philadelphia.

Here he became involved in quarrels with the authorities of Pennsylvania, for which he was tried by court martial. Though acquitted of any "intentional wrongdoing," he was sentenced to receive a reprimand from the commander-in-chief. Washington performed the odious duty as tactfully as possible, couching his reprimand almost in words of praise.

But the proud spirit of Arnold resented the public disgrace, and he began at once to lay plans for revenge. He was financially ruined, moreover, by his extravagance. He asked for and received the command of West Point, the key of the Hudson River, and immediately entered into traitorous communication with the British, planning to surrender his post to the British commander General Clinton. His treachery became known through the capture of Major Andre,

the British spy. But before Arnold could be arrested he escaped to the British army, in which he was given a command and \$30,000.

During the remaining year of the war Arnold served with the British. At one time he led an expedition against his native state, Connecticut, Wherever he went, whether in the North or later in Virginia, his troops burned and plundered and thus added to the hatred in which he was now held by his countrymen.

At the close of the war Arnold went to England to live. There he met only scorn and contempt from those to whom he had betrayed his country. He attempted to obtain a commission in the British army, but failed because of the feeling against him. He then devoted his energies to trade with the West Indies. But his business venture was a failure. After 20 years of life as a social outcast he died a miserable broken-hearted man. His story is indeed that of "a soul's tragedy."

ARRAS (ä-räs'), FRANCE. Like so many of the historic towns of northeastern France, Arras was blown to ruins in the World War of 1914-18. For four years it was scarcely ever out of range of the roaring guns, and of the 5,000 buildings which composed it, only 870 escaped the shells. The stones of former picturesque Flemish buildings today form the foundations of a rebuilt city.

Arras is situated at the center of a network of roads and railways about 50 miles southeast of Calais. It was a position which the Germans were determined to capture, and which the Allies were equally determined to hold. After the first wave of German troops had been driven back in 1914, Arras never again fell into the hands of the invaders, although their trench lines twice ran through the suburbs.

To get a view of the ground where the British won the great battle of Arras in 1917, we must mount to the top of the famous Vimy Ridge, just north of the city. This ridge, taken and retaken at the cost of thousands of lives, was the northern pivot of the celebrated "Hindenburg Line," beyond which the Germans swore they would not retreat.

Looking northeast, almost at the foot of the ridge, you see the city of Lens, the great coal center of France, whose mines were flooded and wrecked almost beyond repair by the foe in the bitterness of defeat. Beyond Lens is Loos, the scene of a tragic battle of 1915, when the British lost 70,000 men.

On Easter Sunday, April 8, 1917, Canadian troops launched their attack on Vimy Ridge, supported by English divisions on their right. A week later the entire ridge had been taken, the Hindenburg Line pierced for a depth of six miles, and the battle was won. In the German spring drive of 1918, all of this ground was retaken, but the defenses of Arras itself remained firm, stopping the thrust at Amiens (see Amiens). The following September the British delivered a second great blow from Arras, which had much to do with compelling the German retreat.

Arras lies on the Scarpe River, a navigable arm of the Scheldt River of Belgium. Its position has always exposed it to the mischances of war, for it lies in the natural path of armies through this part of France. It was destroyed by the Vandals in 407, ravaged by the Normans in 880, and sacked by Louis XI in 1478, after its Flemish inhabitants had rebelled against the French king. Nevertheless, medieval Arras was a celebrated art center. So great was the fame of its tapestry in the 14th and 15th centuries that the British gave the name "arras" to all fabrics into which figures and scenes were woven.

In modern times the city has been the center of extensive iron, oil, dye, and brewing industries. Its religious architecture has never equalled that of the neighboring towns, but in the 16th century was built its celebrated city hall, with a belfry 240 feet high containing a rare set of bells. Population, about 25,000.

ARROWROOT. A delicate starch obtained from the roots of certain wild plants (*Maranta arundinacea*) found in tropical America. It is easily digested and is often used in the preparation of food for children and invalids. The name is believed to have come from the practice of South American Indians, who apply the freshly cut roots to wounds made by poisoned arrows. It is manufactured on a large scale in Bermuda and Jamaica.

AR'SENIC. The word arsenic brings to mind many a dark crime, for arsenic compounds are among the deadliest of poisons and have been recognized as such from ancient times. The element arsenic is a steel-gray solid with a metallic luster. It is found free in nature, and also in combination with sulphur, particularly in ores of the common metals.

The chief use of metallic arsenic is in making lead shot. When pure melted lead is dropped from a height it forms tailed drops, but mixed with a small amount of arsenic the lead forms nearly spherical pellets. Small quantities of arsenic in iron permit the iron to take a brilliant polish, and this mixture is used for chains and ornaments.

It is in various chemical compounds, however, that arsenic is most valuable. Several pigments contain arsenic combined with copper, hydrogen, and oxygen. The most familiar of these is paris green, which is much used as a spray to kill insects, as well as to give vivid green tints in the arts. There is a well-founded prejudice against the use of arsenic to color wall-papers and calicoes, owing to a belief that it gives off poisonous fumes. White arsenic, the compound with oxygen (As_4O_6), is much used in glass-making to take out the color of iron, in rat and fly poisons, in stuffing the skins of birds and animals (taxidermy), and in making colored fireworks. White arsenic has certain important uses also in medicine.

AR'TEMIS. The huntress goddess and her radiant nymphs, after a long and exciting chase, had stopped to bathe their heated limbs in a mossy pool in the wood. Hearing the girlish shouts of laughter, a rash mortal named Acteon, who also hunted in that forest, drew

near, and as he gazed entranced the virgin goddess saw him. A dash of water from her palm into his presumptuous face turned him into a trembling stag with spreading antlers; and as he bounded forth

Artemis is usually represented as a huntress, tall and fair, slender and light of foot. Her hair is bound in a knot at the back of her head, and her dress is girt high for speed. On her shoulder she bears her

THE GODDESS OF THE TIDES



Artemis, whom the Romans called Diana, being a moon-goddess, was supposed to control the tides. This idea an American artist, John Elliott, has expressed in the true Greek spirit by personifying the four great phases of the tides—high, low, spring, and neap—as four horses. The goddess still carries her bow, reminding us that she is also a huntress.

from the thicket he was torn to pieces by his own hounds. Never could his tongue now boast that he had seen the chaste Artemis disrobed!

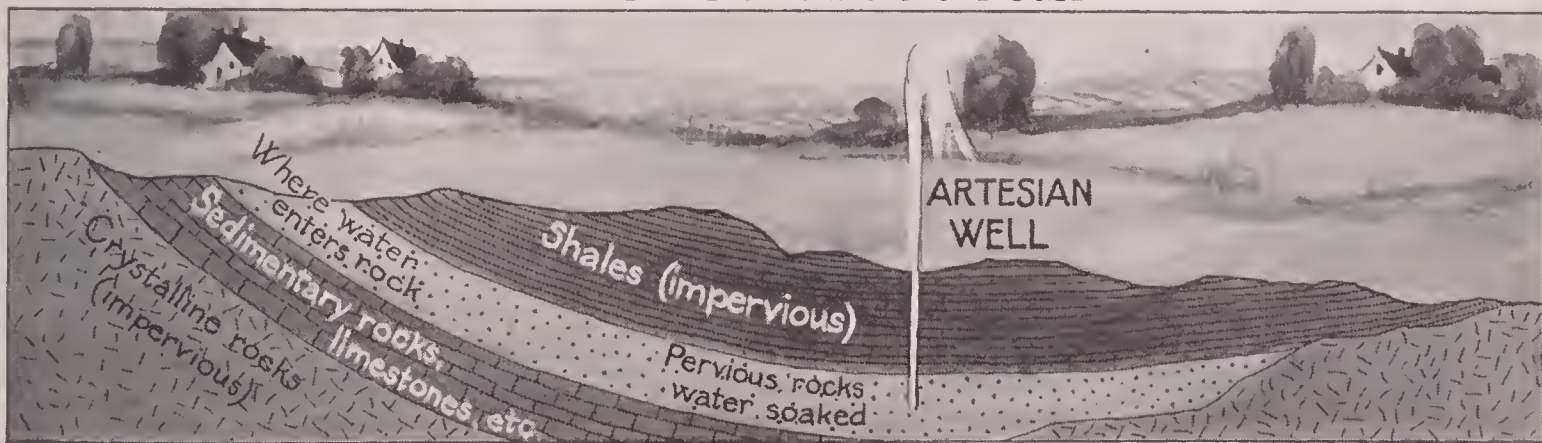
Greek myth tells us that this fair goddess of the bow and quiver, whom the Greeks called Artemis and the Romans Diana, was the daughter of Zeus and the twin sister of Apollo, whom it is said she closely resembled. The Greeks worshiped her as the goddess of chastity and the guardian of youths and maidens. Artemis came also to be looked upon as

bow and quiver, and by her side is a dog or deer. The finest statue of her is that found in a villa of the Roman emperor Hadrian, and now in the Louvre.

At Ephesus, in Asia Minor, a goddess was worshiped under the name of Artemis or Diana, but she differed in many respects from the true Artemis. This Asiatic goddess is noteworthy for her great temple at Ephesus, one of the Seven Wonders of the World, and also because of the allusion to her in the Epistle of Paul to the Ephesians.

ARTESIAN WELLS. Long ago in the French province of Artois it happened that a well was sunk so

A WELL THAT NEEDS NO PUMP



In an artesian well there must be a porous layer of rock overlaid by one which is not porous and thus prevents the water from escaping upward. The porous rock must come to the surface at a place higher than the site of the well. If there is enough rainfall to keep that layer well filled with water, the water, being under pressure, will gush out when an opening is made in the layer above.

the moon-goddess, just as Apollo was viewed as the sun-god. But most of all the Greeks loved to think of her roaming the wilds as the protector of the beasts of the field. Her favorite animal was the deer, though the bear, the lion, and many other wild beasts were sacred to her.

deep that it passed the watertight strata to layers of porous rock and gravel where the water was confined under heavy pressure. At once the water gushed forth, overflowing the curbing; and the name "artesian well" (from the name of the province) is given to such flowing wells to this day.

As you know, most of the water which falls to the earth sinks into the soil or porous rock beneath the surface, and flows out again at some point lower down, forming an ordinary spring. It is only where this water gets caught beneath great layers of water-tight earth or stone and remains imprisoned there, under the accumulated pressure of the water higher up, that artesian wells are possible.

Dry and desert land is often turned into rich fields through the discovery of such underground water-pockets. Artesian wells were sunk in Egypt and China in ancient times. One famous well in France near Passy yields 5,600,000 gallons daily, and the water spouts 54 feet above the ground. The deepest well, located near Leipzig, Germany, reaches down more than a mile. In the United States the cities of St. Louis, Columbus, Louisville, Galveston, and Pittsburgh receive part or all of their water supply from artesian wells. The water of the deeper wells is often warm. Two wells near Edgemont, S. D., nearly 3,000 feet deep, yield 1,000,000 gallons daily at a temperature of 100 degrees.

Artesian wells are used for irrigation chiefly in the states of South Dakota, New Mexico, Texas, California, and Montana. Perhaps the most useful of the artesian wells are those in the Sahara Desert, where all other water supply is lacking. (*See Springs.*)

ARTHUR, CHESTER ALAN (1830-1886). Chester A. Arthur has the curious distinction of proving a better president than most people expected him to be.

He was elected as vice-president on the Republican ticket in 1880, and became the 21st president of the United States amid the universal gloom caused by the death of President Garfield (Sept. 19, 1881). He was known as a thorough-going partisan politician, and was closely allied to the group of "Stalwart" Republicans, under the leadership of Senator Conkling of New York, whose bitter opposition to the President had inflamed the mind of his crack-brained assassin (*see Garfield, James A.*).

But Arthur possessed valuable personal characteristics which aided him in the presidency and agreeably

disappointed the expectations formed of him. He was a polished gentleman, noted for many acts of kindly consideration for others. He had received a good education, having been graduated from Union College (Schenectady, N. Y.) in 1848 with high honors. Removing to New York City from his native Vermont, he had become a brilliant lawyer and had won

fame in two noteworthy lawsuits. The first was the famous Lemmon case, before the Civil War, in which Arthur won from the court the decision that a slave who was brought into New York State thereby became free. In the other he brought suit against the street-car company of New York City for a negro woman who had been put off a car because of her color; as a result of the suit negroes secured the same rights on the cars in New York State as white people enjoyed.

Arthur in the Civil War

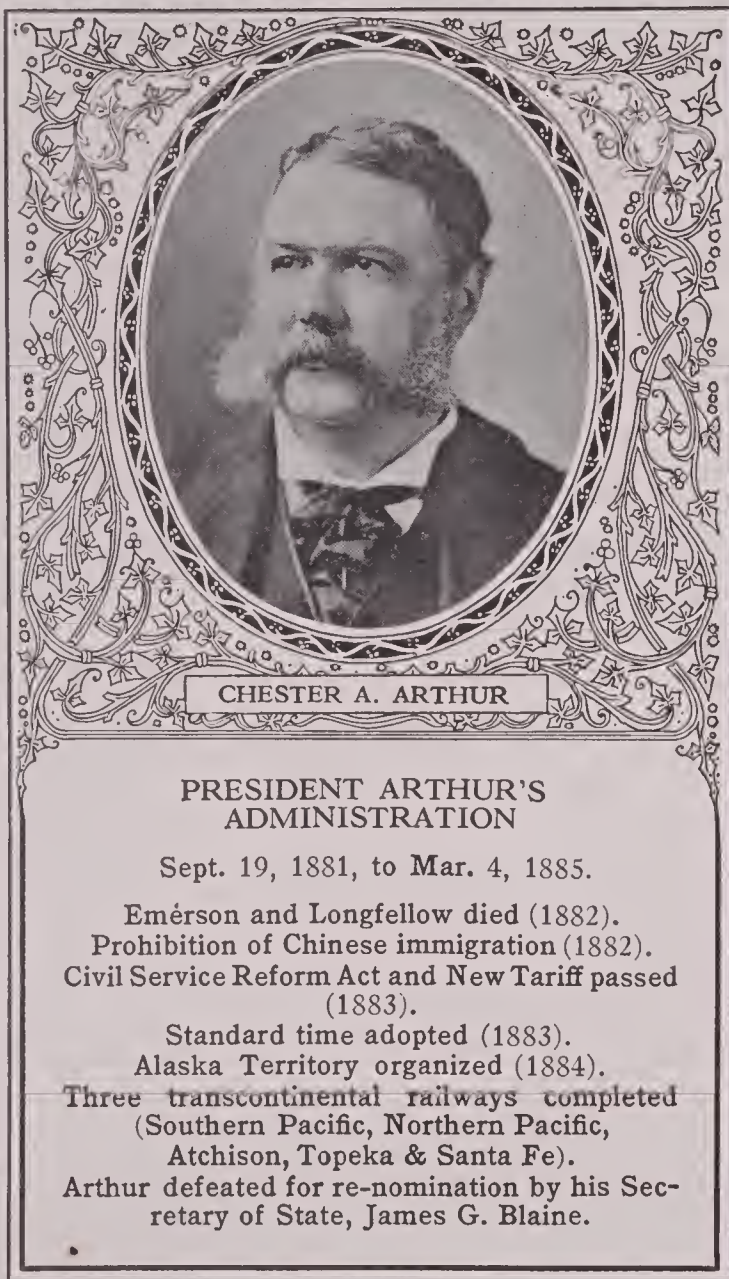
Though Arthur had defended negroes in these two cases, he was not an abolitionist. His only participation in the Civil War was in the positions of inspector-general and quartermaster-general of the New York forces, which were political positions; and after 1862 he took no part at all in that great conflict.

From the close of the war until his death Arthur devoted all his attention to law and to politics.

Because of his services to

the Republican party, President Grant, in 1871, appointed him to the well-paid office of collector of the port of New York. It was his conduct of this position which won him the distrust of the people. Though he recognized the evils of the public administration, he refused to reform his own office, claiming that "to the victor belong the spoils." When President Hayes undertook the reform himself, and asked Arthur to resign, Arthur refused on the plea that he was no worse than other public officials, whereupon Hayes removed him.

People were, on this account, afraid that the spoils system would prevail in Arthur's administration when he unexpectedly became President. But Mr. Arthur seems to have felt keenly the criticism directed against him, and his new responsibilities doubtless



sobered and ennobled his purposes. He surprised the country by yielding to the demand of the people against the politicians, and urged Congress to pass a civil service reform bill. This was done in 1883, in the Pendleton Act.

Two other important laws were passed in President Arthur's administration—the Edmunds Act, which forbade polygamy in United States territories, aimed at the Mormons; and the Chinese Exclusion Act, which prohibited the immigration of Chinese. Though there were no dramatic incidents during his administration, Arthur's policy gave general satisfaction to the country. His failure to secure the Republican nomination for reelection, in 1884, was due to quarrels within the party.

The period of President Arthur's administration was one which was marked by growing prosperity in the country. The South, slowly recovering from the

prostrating effects of the war, increased its cotton crop from five to eight million bales, and was raising grains, fruits, and vegetables as never before. The beginning of industrial revolution was also apparent which was to make of Alabama, Georgia, and other states new manufacturing centers. Expositions held at Atlanta in 1881 and New Orleans in 1884 gave convincing testimony to this revival of the war-devastated states. The West, too, made rapid strides, with the completion of three new transcontinental railroads—the Southern Pacific in 1881, the Northern Pacific in 1883, and the Atchison, Topeka and Santa Fe in the same year. Brooklyn bridge, regarded as one of the wonders of the world, was opened in 1883, and Alaska was organized as a territory in 1884.

At the close of his term as president, Arthur retired to New York City, where he continued to reside until his death on Nov. 18, 1886.

The GLORIOUS FOUNDER of the "TABLE ROUND"

How an Ancient British Chief Became a Hero of Romance

ARTHUR, KING. No figure in literature more completely embodies the ideal virtues of knighthood than does this legendary prince of the ancient Britons. But of the historical truth of the stories told about him we can only say, in the words of one of the old writers, that they are "not all a lie nor all true, not all fable nor all known—so much have the story-tellers told and the fablers fabled, in order to embellish their tales, that they have made all seem fable."

The real Arthur seems to have lived in the 6th century and to have gained fame as a leader of his people in the days when the Romans, after ruling the island of Britain for three centuries, abandoned it to the rising power of the barbarians. It is not certain whether the enemies against whom Arthur fought were the heathen Scots or the heathen Saxon invaders. In any case he was finally defeated. The conquered Britons, who fled to the mountains of Wales and to Brittany in France, began to tell wonderful stories of Arthur's valor and goodness, and even fancied that he had not really died but would one day come again to give them victory.

Later, the knights and poets of chivalry, because Arthur had been a Christian fighting against heathen, fancied him a knight like themselves, and about his

name there began to cluster a cycle of tales in which many other knights appeared. These were said to be members of King Arthur's Order of the Round Table, about which all sat as equals under their liege lord.

In these stories Arthur appears as the son of King Uther Pendragon and the husband of Guinevere, the fairest princess in the land. He maintains his court at Caerleon, in Wales. Percival, Tristram, Galahad, Lancelot, and the enchanter Merlin are among the members of his circle. One set of legends tells of the search for the Holy Grail, a mystic cup connected with Christ's crucifixion, which only the pure in heart and deed might gaze upon.

In the end Arthur is killed in battle by his nephew Modred, who has revolted against his rule. Arthur's body is mysteriously carried to the island of Avalon to be healed of its wounds, whence he is expected to return in after ages to restore the rule of right.

The stories of King Arthur were written down by Geoffrey of Monmouth about 1136, and by various French writers of a slightly later date. Sir Thomas Malory, an Englishman who lived about 300 years later, translated the stories of the old French writers and published them in one of the first English printed books, entitled 'Morte d' Arthur' (The Death of Arthur). It is from this source that modern writers, including Tennyson in his 'Idylls of the King', have drawn their tales concerning Arthur.

How Arthur Won His Crown

LONG, long ago, according to this story, Arthur was the goodliest youth in all Britain. Handsome, brave, true-hearted, and gentle-mannered, he had grown up in the old gray castle of Sir Hector, and he had always thought of himself as the son of that good knight, and younger brother to Sir Tor and Sir Kay.

One day they all rode up to London. King Uther had long been dead, and the Archbishop had commanded the nobles to meet in the great church and

choose a new ruler. Sir Kay, who had just been knighted, forgot his sword and asked Arthur to go back for it. The drawbridge was up, and the warden was so deaf that Arthur could not make him hear.

Unable to get into the castle Arthur stopped at the churchyard and drew forth a splendid sword that he saw fixed upright in an iron anvil in the midst of a great stone. When he told Sir Hector where he had found the sword, the good old knight knelt and kissed Arthur's hand.

KING ARTHUR AND HIS KNIGHTS OF THE ROUND TABLE



These two pictures are from the decorations by the distinguished American artist, Edwin A. Abbey, on the walls of the Boston Public Library. In the lower picture Sir Galahad is about to take his place in "the Seat Perilous" at the great Round Table with King Arthur and his knights. He is led by the mysterious figure of his ancestor, Joseph of Arimathea, the first possessor of the Grail. King Arthur rises from his seat to receive the virgin knight, the purest of the pure. The upper picture shows Sir Galahad and his fellow knights receiving the benediction in the cathedral before starting on the quest for the Holy Grail.

"Sire," he said, "it is your own. That was the sword of your father, King Uther. No one but his true heir could have drawn it from the anvil."

Then Arthur learned that when King Uther died the wise magician, Merlin, had fetched him, the infant prince, to Sir Hector. To hide him from enemies who would have killed him, the good knight had brought him up as his own son. Merlin had told the holy archbishop to so fix the royal sword in the anvil that only King Uther's son could draw it forth.

At Christmas, Twelfthday, Candlemas, and Easter, Arthur was called upon to prove his right to the throne. The greatest nobles and knights in the land were unable to move the sword when it was replaced in the anvil, but when Arthur touched the golden jeweled hilt the blade came free. So Arthur was crowned King, and as a sign that he dedicated himself to God, he laid the royal sword on the altar.

There are many other stories of this famous monarch. They will always be read and told, so that the world never can forget how love and truth and justice reigned, "when good King Arthur

ruled the land." (See Galahad; Round Table.)

ARYAN (*ār'yan*). The great group of languages which includes English as well as most of the languages of Europe is often called the Aryan or Indo-European family. Persian, Armenian, and Sanskrit (a language of ancient India) also belong to this family. Formerly the term Aryan was applied not only to this group of languages but also to the peoples who spoke them. Most scholars today prefer to restrict the use of Aryan as a race name to the eastern branch of the Indo-European peoples, which includes the ancient inhabitants of Persia and northern India and their modern descendants. (See Philology; Races of Mankind.)

'AS YOU LIKE IT'. In a greenwood forest, according to this delightful comedy of Shakespeare, lived a banished duke together with many loyal courtiers who had followed him into exile. Thither a little later came this banished duke's sweet and lovely daughter Rosalind, also banished, and disguised as a page. Her lover Orlando, fleeing a cruel brother, came likewise to the happy forest of Arden, where there was "No enemy but winter and rough weather."

Unrecognized in her disguise by either her father or her lover, Rosalind played many a merry caper with both before revealing who she was. Her pretty wit, the clownish humor of the faithful fool Touchstone, the acid wisdom of the melancholy courtier Jacques, and the Duke's calm philosophy in misfortune, make 'As You Like It' still a favorite play of the stage. The Duke, for instance, describes the charm of life "under the greenwood tree," in these famous lines:

And this our life, exempt from public haunt,
Finds tongues in trees, books in the running brooks,
Sermons in stones, and good in everything.

ASBESTOS. This remarkable mineral owes its value to the fact that it contains fibers which can be separated and woven into a soft white fabric indestructible by fire, acid, or time. Several varieties of mineral crystals, sold under the name of asbestos, produce the perfectly smooth delicate fibers used for this purpose. In manufacturing asbestos goods, the fibers are separated from the non-crystallized rock by a crushing machine and are then combed, carded, and spun in much the same way as wool. From these threads are woven fireproof curtains for theaters, indestructible carpets that grow tougher with age, and cloth for upholstering and many other purposes. Poorer grades have stiff coarse fibers which cannot be woven, but which are worked into fireproof paper and materials for insulating hot pipes and the wires of electrically heated devices.

The ancient Greeks knew the peculiar qualities of this strange mineral and gave it the name asbestos, which means "unburnable." Charlemagne is said to have had a tablecloth of asbestos which was cleansed by being thrown into the fire.

WHERE MOST OF OUR ASBESTOS IS MINED



This is a section of one of the famous Thetford mines in Quebec, known as "Bell's Pit." The crane lifts out the ore and, turning, deposits it on the car which carries it to the crushing plant.

The most important of the minerals known as asbestos is *chrysotile*, most of which is mined in the Thetford district in the province of Quebec, Canada. Other varieties are *actinolite* and *anthophyllite*. The United States, Australia, South Africa, Italy, Corsica, and the Tyrol are important sources of production. In the United States, Arizona is the only state that produces asbestos of quality good enough for spinning. Georgia, California, Idaho, and Virginia produce low-grade fiber which is used chiefly for electric and heat insulation.

ASH. For the manufacture of carriage shafts, ladders, handles of agricultural tools and other articles in

ASH TREE LEAVES AND "KEYS"



This picture shows the chief identifying marks of the beautiful ash tree—its tall, limbless trunk, the leaves, and a cluster of the winged seeds known as "keys." The ash tree blooms in clusters of reddish flowers in March and April before the leaves develop. The "keys" often remain hanging in bunches after the leaves, which fall early, are gone.

which lightness, pliability, and toughness are essential, the ash tree has only one important rival in America, the hickory. Its tough, hard white wood has been found very valuable also for making carriage wheels. The lumber from the gnarled specimens is often beautifully grained and is used for cabinet work and veneer. The bark is used to some extent in tanning.

The tree is tall and slender, often reaching a height of 120 to 150 feet. The trunk is bare of limbs to a considerable height. In the early spring small naked flowers appear on the slender branches, the broad leaves opening much later than those of other common trees. Through the summer the foliage is beautiful, but it withers early in autumn.

There are several species of this tree, thriving in many countries. In America the most common is the white or American ash, which is found in Canada and the United States west to Minnesota and Texas. Other species are found in New England, the Middle States and in the West. Though a rapid grower and beautiful and graceful as a shade tree, the ash is not much used for ornamental purposes. This is partly on account of the many roots which lie near the surface, exhausting the soil and killing the grass and shrubbery. The so-called "mountain ash" or rowan tree, whose berries of orange red are so conspicuous in autumn, is not a true ash. (See Mountain Ash.)

Scientific name of American ash, *Fraxinus americana*, Flowers, insignificant, appearing before the leaves. Leaf, compound, opposite, odd-pinnate. Seeds, winged. Bark, brownish-gray tinged with red; young shoots are glossy, marked with light colored dots.

ASIA, *the* GREAT MOTHER *of* CIVILIZATION

A SIA. Stretching from the frozen plains of the Arctic Circle to the tropical forests of the Malay Peninsula, and from Europe and Africa to within 36 miles of North America, Asia includes nearly one-third of the dry land of the globe. It is so much the largest of the six continents that you could put all North and South America upon it and have a million square miles to spare; or Europe, Africa, and Australia, and come only a million square miles short. Asia contains the highest lands of the world and the lowest, the wettest and the driest, and regions where the variations between heat and cold are most extreme. It is the cradle of the human race, of all religion, wisdom, and civilization. With vast resources and more than half the population of the whole world, it contains the future of civilization as well as its past.

On the Desolate Roof of the World

There are people in Asia who will tell you that they pasture their flocks on "the roof of the world." That is what they call the Great Pamir region in Turkestan, the highest place we know of. Its valleys are 10,000 to 17,000 feet above sea level, higher than the tallest peaks of the Alps or the Rocky Mountains, and its mountains rise 10,000 feet higher still. In fact this whole region with its area of 30,000 square miles lies so far in the cold upper air that although it is as southerly as the state of Georgia it has only three weeks of real summer. Spring and autumn last two months each, and for the rest of the year the lakes are frozen as solid as stone. Nothing has time to grow except the patches of grass that furnish such fine pasture for the sheep of the Kara Kirghiz nomads.

The Great Pamir is not really the roof of the world, but only the ridge of the roof. Just east lies the mysterious country of Tibet, the highest inhabited place on the globe. Tibet is one-seventh the size of the United States and lies at altitudes of from 14,000 to 17,000 feet. So cold and rare is the atmosphere that the people rely more on the long-haired yak as a beast of burden than on the less hardy horses.

The roof has its gables as well. One of these is the basin of the Koko-Nor or Blue Lake at the edge of Tibet, lying at an altitude of about 9,000 feet; another, the Iranian plateau, including Afghanistan, Baluchistan, and Persia; another, Asia Minor; and a fourth the Deccan, covering the V of the peninsula of India and having an average height of from 1,500 to 2,000 feet.

Extent.—North to south, 5,300 miles; east and west, 6,500 miles; area, about 17,250,000 square miles.

Population.—About 900,000,000, more than all the rest of the world together; chiefly of the yellow race (Chinese, Japanese, etc.), with groups of the white race (Semites in Syria and Arabia, Slavs in Siberia, etc.), and negroid groups in southern India and Ceylon.

Mountains.—Himalayan system, with four highest peaks in the world, including Mount Everest, 29,002 feet, and Kanchanjanga, 28,156 feet. Continuations: Hindu Kush through Afghanistan, Persia, to Elburz range south of Caspian Sea, highest peak Mount Demavend, 18,460 feet, to Mount Ararat, 17,000 feet; mountains of Armenia, Caucasus, Taurus in Asia Minor; Tien Shan to northeast Altai and Sajansk ranges. Ural Mountains between Asia and Europe.

Plateaus and Deserts.—Tibet, highest plateau in the world, mean height 15,000 feet; plateau of Iran, including Afghanistan, Baluchistan, and Persia; Armenian plateau; plateau of Asia Minor; Pamir plateau, valleys 10,000 to 17,000 feet above sea level; Deccan plateau in India; Arabian desert; Gobi desert; Takla Makan desert; Kirghiz, and Siberian steppes.

Principal Rivers and Lakes.—In Siberia, Yenisei, Ob, Lena Rivers; in China, Amur, Yangtze, Hwang, Tarim; in India, Ganges, Brahmaputra, Indus; in western Asia, Tigris, Euphrates, Caspian Sea, Aral Sea, Lake Balkash, Lake Baikal.

Chief Countries.—China, Japan, Siam, Afghanistan, Persia, Turkey, Siberia. Under foreign rule: India and Burma (Great Britain), Korea (Japan), Anam (France).

You might say that Asia contained the cellar as well as the roof of the world. The Dead Sea to the north of the Arabian peninsula lies 1,300 feet below sea level and is the deepest hollow in the lands of the world. The Great Pamir itself sheers off into the lowlands about the Caspian Sea, which is 85 feet below sea level.

However, more than one-twelfth of the surface of Asia has an elevation

of over 10,000 feet, so that even with the lowlands its mean level is three times as high as that of Europe. The four mountain systems that radiate from the Sarikol range in the Great Pamir—the Hindu Kush to the west, the Himalaya to the southeast, the Kuenlun to the east, and the Tien Shan to the northeast—are the loftiest in the world. Mount Everest in the Himalayas, with a height of about 29,000 feet, is the highest peak in the world, and has never yet been climbed to the top, while three other Himalaya peaks look down upon all other mountains. In these "abodes of eternal snow" (that is what the name Himalaya means) the great rivers of India and China take their rise.

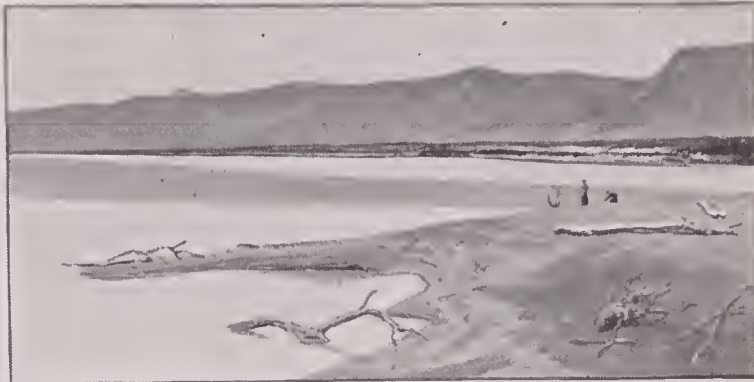
From the Frozen Tundras to the Tropics

The northernmost point of Asia is Cape Chelyuskin in Siberia, lying within 12 degrees (about 800 statute miles) of the North Pole. If you should travel from there to the southernmost point, which is Cape Romania at the tip of the Malay Peninsula, within a degree and a half of the Equator, you would have covered a distance of 5,300 miles as the crow flies. Along the northern shores you would see the *tundras* or frozen plains stretching down to the frozen Arctic Sea, and except for the lines of driftwood would hardly know where land ended and the sea began. The plains freeze so deep that even a sun shining day and night at midsummer only thaws the ground for a few inches—just deep enough to give root to a few berries and to the moss that reindeer eat. The people live in skin tents, dress in furs, and lead a wandering or nomadic life, following their reindeer from one pasturage to the next, and hunting and fishing as they can. The reindeer furnish them their meat and milk and the skins for their tents, and serve to draw their sledges as well, in a country where horses could not live. In winter the temperature is sometimes as low as 92 degrees below zero, but in summer it often reaches 100 degrees above, and mosquitoes and midges swarm over the warm marshy ground.

SEVEN STRIKING FACTS ABOUT ASIA



In Asia is the highest point on the globe. Mount Everest on the borders of Nepal and Tibet rises 29,002 feet above the sea.



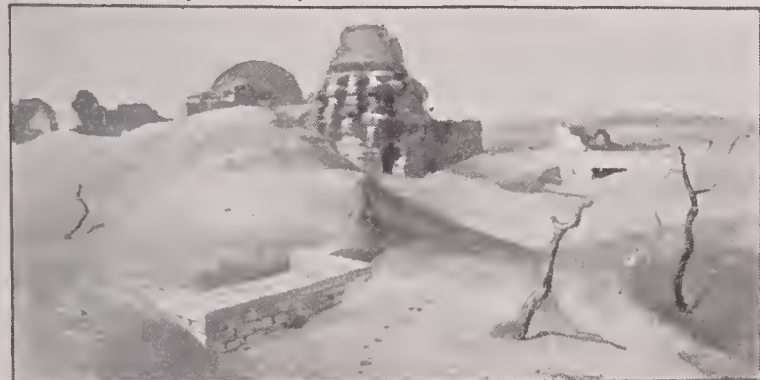
On the other hand, the Dead Sea lies in the deepest hollow in the world, 1,300 feet below sea level, in southern Palestine.



More than one-half of all the world's people live in Asia. Here you see the Arab, the Turk, the native of India, and the Chinaman.



No zoo contains such a variety of animals as the jungles of Asia, and no botanical garden has such a variety of vegetation.



In the wastes of Asia are many such ancient ruins which are being fast buried by desert sands. This is a scene in the desert of Gobi.



Contrast the scene of arid desolation in the Gobi desert with this view of the lands of the monsoons in India, the wettest region in the world.



Asia is not only the largest continent, but also the highest. These two pictures illustrate how the piled-up mass of Asia (represented on the right) compares with the average altitude of Europe. It is about three times as high.

To the south you would find a people for whom life is as easy as it is hard for the tundra people. The tribes of the Malay Peninsula need only to hunt the animals or eat the fruits of the tropical forests, grow rice in the wet jungles, or by one month's work preparing sago have their food for the year assured.

In traveling from the west of Asia to the east you would make a longer journey still. It is 6,500 miles from Cape Baba on the Mediterranean, the easternmost point, to Bering Strait, the westernmost. If our own standard time (which changes one hour for every 15 degrees) prevailed in Asia, we should have to change our watches ten times in making this journey, as compared with three changes between Boston and San Francisco.

On the west, Asia touches Europe at the Ural Mountains, a range of hills the highest of which is not so high as Mount Washington in New Hampshire, and the Caucasus, which forms the parting line between the animal and vegetable kingdoms of Europe and Asia as well as between the continents themselves. It nearly touches again at the two ends of the Sea of Marmora, the Bosphorus and the Dardanelles. Because of this close connection between Europe and Asia, geographers sometimes refer to the two continents jointly as Eurasia. From Africa, Asia is separated only by the Red Sea, ending in the Suez Canal to the north, where you could almost step from one continent to the other, and in the narrow Strait of Bab el Mandeb to the south.

On the east there is one point at which Asia almost touches North America, for Bering Strait at its narrowest is only 36 miles.

How the Map of Asia Resembles Europe's

Three of the boundaries of Asia are oceans, the Arctic, the Pacific, and the Indian. Since the coast line is broken by peninsulas and hemmed in by islands, these great bodies of water are divided up into a series of seas, gulfs, and bays. The most important of these, from north to south, are Bering Sea, the Sea of Okhotsk, the Japan Sea, the Yellow Sea—so called from the yellow mud of the Yangtze River that colors it for a hundred miles from the shore—the China Sea; and then as you turn the corner going west, the Gulf of Siam, the Bay of Bengal, the Arabian Sea, the Persian Gulf, and the Gulf of Aden. Of these even the comparatively small Persian Gulf is more than three times as large as Lake Superior.

The shape of Asia may remind you a little of Europe, magnified of course to many times the size. The Arabian peninsula would be Spain, the Indian peninsula Italy, though its area is really one-half that of all Europe, and the Indo-Chinese peninsula would be Greece, with the eastern archipelago taking the place of the Aegean Islands. Then you might think of the Japanese Empire as balancing the British Isles.

Notice, however, that the eastern coast of Asia has not one set of islands but a whole fringe of them. This fringe extends from the very north to the south so far that you cannot be quite sure at first where the islands of Asia end and the islands of Australasia begin. Science has, however, drawn a line of demarcation—the Wallace line, named after the naturalist who first indicated it—at the Strait of Macassar, between Borneo and Celebes, where the Australian flowers and animals begin to predominate. The Philippine Islands are a part of the Asiatic fringe, lying east across the China Sea from the Indo-Chinese Peninsula.

So Many Mouths and So Little to Eat

In Asia you will find more than half of the people of the whole world. Two-thirds of them are yellow people, almost all the rest white, with a scattering of black people in India, and a brown race in the Malay Peninsula, which has no well-defined relation to the others.

At first as you look at the map it seems strange that Asia should support so large a population. Most of the continent consists of places where no one can live at all, or where people can only hunt or graze sheep or reindeer. Even in China, which contains more people than any other country in the world, there are vast tracts of waste country.

Most of Mongolia consists of the Gobi desert. This is one of the most desolate regions in the world. It is still so little known that story writers feel safe in making it the scene of amazing adventures along the route of the camel trains that brave the stinging sand and dust storms to trade between China and Siberia.

The sands are now covering the countries round about Gobi. In the Lob Nor (*nor* means "lake") basin to the west sand has choked up a whole inland sea until it is now merely a series of marshy lakes in which the once great river Tarim loses itself. Dunes as high as hills are threatening the river, and explorers have found in the region known as the Takla Makan desert ruins of great old cities buried in the sand. This country, merging into the Gobi and called Chinese Turkestan, is almost as dreary and barren as the desert itself.

Here and there, however, you will see little oasis settlements surrounded by fields of grain and scant patches of beans and melons, and shaded by dusty-looking walnut and mulberry trees. Here, too, are large cities, important trading centers for the merchants from China, India, Bokhara, and Russia. In the bazaars of Yarkand, Kashgar, and Khotan you will see people exchanging bags of musk for cheap tea which is made into bricks that often serve as money, or haggling for bright-colored silks and cottons. You will see coppersmiths, saddlers, weavers, and cooks all busily plying their trades in full view of possible customers, while water carriers and jugglers move about among a crowd exhibiting all the costumes of Asia.

Asia's Creeping Sands

These Chinese desert lands, including part of fertile Manchuria to the north, are only one section of a broad belt of desert that extends all the way across Asia to the Sahara in Africa. Russian Turkestan—beginning at the Pamirs and the Tien Shan mountains—is a desert country like Chinese Turkestan. The sands are drying up the Oxus River, or Amu as it is called today. Its outlet, the Aral Sea, all that is left of a large inland ocean, is disappearing so rapidly that geologists making observations every ten years can almost see it going.

In this desert of Russian Turkestan are the shrunk-en modern remnants of great cities of old time. Merv lies in a fertile oasis of nearly 100 square miles, and 20 or 30 square miles of it are ruins. It was here that the traders of China came with silks and spices and pearls to meet European traders in the days before history, and here that Alexander destroyed one great city and built another. Other old oasis cities are Tashkend, Samarkand—which was the capital of the great Mongol conqueror Tamerlane—Bokhara, and Khiva. Afghanistan and Baluchistan are also a part of this desert, and a considerable tract of India east of the Indus River.

The central part of Persia is also a desert. You can see the sands creeping up and drifting in upon the city of Yezd, dooming it as the cities of Chinese Turkestan were doomed. The river system, choked with sand, is a network of watercourses running nowhere, and no longer makes fertile a land which once blossomed like the rose. The westernmost peninsula, Arabia, is all desert except the very rim, and with the exception of the once fertile Tigris-Euphrates valley, it has always been so. Across its burning sands cara-

A PICTURE-JOURNEY FROM THE HIMALAYAS TO JAVA



Towers of Victory



The Famous
Bolan Pass



Village
in the
Himalayas



Chinese Floating Village



Wash-day in Java



Forest in Java

Towers of Victory such as those at the top are frequent sights throughout India. They were erected by Indian potentates to commemorate their deeds of prowess. Next we pass to a village of the Himalayas, then get a glimpse of laundry methods in Java, and of one of the dense forests of that rich island. Of the two and one-half million population of Canton, China, more than 600,000 are born, live, and die in boats like those shown in the next view. We finish our trip by a visit to the famous Bolan Pass, between Baluchistan and India proper—one of the two northwestern gateways to India.

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vans patiently make the 60-day journey from Damascus to Mecca, or traverse the ancient route to Bagdad.

Nor are the deserts and mountains the only places where few people can live. On the rim of the deserts are waving plains of grass, which the Russians call steppes. The Asiatic steppes, extending from Manchuria across Mongolia, Turkestan, southern Siberia, Asia Minor, Persia, and Arabia, cover an area far greater than the whole of Europe. These grasslands, too dry for agriculture either because they lie too high or because they are too far inland to receive rainfall, furnish rich pasture. Scattered nomad tribes wander from pasturage to pasturage during the season when the grass springs up. When the sun has dried the last of it to a reddish brown mass hardly distinguishable from the desert itself, the wandering peoples return to some oasis to wait for the next growth.

In Arabia these nomads are called Bedouins. They live in prosperity, dependent only on their flocks and herds for meat, skins, milk, and wool. They are, however, very warlike and exact toll from caravans, railroad trains, and oasis cities alike. Pitched battles between the city people and these plain dwellers are not infrequent.

Russia's "Wild West"

Similar people are the Kirghiz of Siberia, whom you can tell even in a railway station by their long sheepskin coats, high red boots, and small caps edged with fur. The Siberian steppes have been to Russia in Europe what the great West beyond the Mississippi was to the United States, with its limitless grasslands and limitless opportunities. Another Kirghiz race is represented in the people who pasture their flocks on the roof of the world.

There are still other vast regions in Asia that support few people. The Siberian forest stretches nearly across the continent in a belt 5,000 miles east to west, and 1,000 to 2,000 miles broad. In some places its dark recesses have hardly been penetrated by man. It is visited chiefly by the hunter seeking rich skins, wolf, bear, fox, sable, and squirrel—for in these cold forest depths the animals grow fur of surprising thickness and luster—and by migratory tribes from the tundra or frozen plain who come here to fish in the dark forest streams. Here and there you will find a clearing with a few log huts clustered together, but scarcely a town and never a city, for hunters and fishermen are not city dwellers nor do their simple life and limited wants support more than a trading post. In the jungles of the Ganges valley in India, the elephants, monkeys, rhinoceroses, tigers, buffaloes, wild boars, and wolves are scarcely asked to share their territory with human inhabitants. The same scarcity of population characterizes the dense tropical forests of the Malay Peninsula.

The Human Swarms of China and India

What then is the secret of the vast population of Asia when so large a part of the land is desert, grassland, forests, and mountain peaks? If you should visit the great river valleys of China and India you

would see. China contains half the people of Asia, or 25,000,000 more than all Europe. India contains almost as many as North America, South America, and Africa together.

The Yangtze in China is the most densely populated river valley in the world. The river is navigable for 2,000 miles or more and all along its banks are little farms hardly bigger than a pocket handkerchief. Here for thousands of years people have grown crops and kept their soil fresh by the use of river mud and other fertilizers. People live even on the river itself, in little boats called sampans, whose matting roofs are the shape of half a barrel. These river dwellers keep shop and even grow things on their boats. In the valley of the Amur to the north there is a smaller population, but people fairly swarm along the fertile Hwang River. More than 12 centuries ago China constructed what is practically a fourth great river, the Grand Canal, 600 miles long. Following this and countless smaller canals are more of the tiny close-packed farms and flooded rice fields. Where mulberry groves are planted for the silkworm, crops are grown between the rows of trees, for not an inch of soil must be wasted.

In India, too, there are swarming river valleys, particularly the Ganges, and the fertile valley between the Ganges and the Brahmaputra. The Indus valley is less productive owing to the Indian desert just west of it, but the fertile soil is now being reclaimed by irrigation. In all, India has a population three times as great as that of the United States.

Other Great Rivers of Asia

The three chief rivers of Siberia, the Ob, the Yenisei, and the Lena, of course do not support such great populations. They are broad and deep enough to be navigable, and the soil is fertile, but they are frozen too much of the year. The great rivers of western Asia, the Tigris and the Euphrates, water a valley which was of the greatest productiveness 5,000 years ago, but is today little developed.

Other countries where a great many people live are those which are blessed by rain-laden ocean winds breaking against mountains. Thus the Empire of Japan, which for all its hundreds of islands has an inhabitable area little larger than California, contains more than half as many people as the whole United States. Siam, five times the size of the state of New York, has about a tenth as many people as all the states.

To make up for its many dry places, Asia contains the wettest region in the world. This is Assam, south of the eastern Himalayas. It has a recorded rainfall of 800 inches as against the less than ten of northern Siberia, Arabia, Persia, and the Gobi desert. This warm wet climate with enough of a slope to drain the water from the roots of the plant is just what is needed for tea-growing, and tea is the industry of Assam as it is of the warm moist island of Ceylon.

Asia has been called the cradle of the human race, and some scientists have pointed to definite regions

BUSINESS LIFE ON THE ROOF OF THE WORLD



The yak is one of the handsomest animals in the world—in spite of his looks—if we regard him from the standpoint of the well-known proverb "Handsome is as handsome does." The yak is to the people of Tibet what railroad trains and steamships are to our part of the world; he is always carrying freight for somebody. The cows of the yak family furnish milk, and the skin of both cows and bulls is used for clothing. You can be sure people have to have good warm clothes up among such vast snow-clad mountain ranges.

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such as the Caucasus or Asia Minor as the first abode of civilized man, the place from which he migrated to Europe and southern Asia carrying his primitive culture with him.

However this may be, Asia can show remains of the oldest known civilization in the world except Egypt. At Troy in Asia Minor, the peninsula lying between the Mediterranean and the Black Sea, the heroes of Homer were fighting 3,000 years or more ago, and archeologists have found on the same site cities still older than the one they fought for. In Caucasia, the broad isthmus between the Black Sea and the Caspian, lay Colchis, the rich and fertile land whither Greek legend says that Jason went in search of the Golden Fleece. Scientists tell us that here the stone-fruit trees such as the peach, the apricot, and cherry first developed from the same wild ancestor. Here, too, are the ruins of the great old cities of Armenia, and here rises the snowcapped peak of Mount Ararat, nearly 17,000 feet high, where the Bible tells us Noah's ark struck land.

Palestine along the Mediterranean coast of the Arabian peninsula is the scene of Bible story and of the development of the ancient Hebrew civilization. Persia as a political power dates back to 559 B.C. when Cyrus made his sweeping conquest. And oldest of all civilizations in the world except Egypt is that of Mesopotamia in the Tigris-Euphrates valley, where there were great cities as early as 3,000 B.C., followed by the empires of Babylonia and Assyria.

In the two other fertile flood plains besides Mesopotamia—where people could cultivate the arts of peace protected by ocean, desert, and mountain barriers—there were early civilizations, though as yet the historians have not been able to prove quite how old. In China there are definite records as far back as 1100 B.C. In India the princes rode on elephants and lived in splendid palaces at the time of Alexander's campaign to the Indus in the 4th century B.C.

For thousands of years, however, the civilization of Asia stood still. The Indians of Alexander's time were skilled in all the arts they ever possessed down to the time of the British occupation. The Chinese preceded Europe in the invention of printing, paper making, porcelain, guns, gunpowder, fine weaving, and perhaps the compass. But having found a good way of writing, governing, making cloth, and tilling the soil 3,000 years ago, they simply stopped hunting for new ways.

The Arabs sweeping over the feeble remnants of Greek and Roman civilization in the early Christian centuries absorbed and developed the learning they fell heir to. Throughout the Middle Ages they led the world in agriculture, building, weaving, metal working, and mathematical science. But their culture has remained at the same stage ever since, while the West has been forging ahead.

Today most of Asia is politically in the hands of Europe. Russia has put her stamp on the new country of Siberia and the old countries of Central Asia and

Transcaucasia, more than one-third of the area of the continent. England has occupied India and scattered points such as Aden, in Arabia, so that at the beginning of the World War she already controlled one-ninth. In Arabia and Persia, too, European forces are at work, and the new governments of these lands now freed from Turkish rule will no doubt progress under European guidance. China is riddled with foreign influences. Japan, the one Asiatic nation which has remained absolutely independent, has done so at the price of accepting western methods in all the arts of war and of peace.

Where All the Great Religions Were Born

Asia has been the cradle not only of civilization itself, but of all the great religions. Out of Mesopotamia came the germs that developed into the three systems that now hold the whole western world. The first was Hebraism, which developed very early in Palestine. From Hebraism sprang the other two, first Christianity, and in 622 A.D. Mohammedanism. The latter from small beginnings at Mecca and Medina in the Arabian desert became the most warlike proselytizing religion of the world. In the Middle Ages it extended even to Spain. Today it numbers 175,000,000 in Asia and Africa alone.

From the Aryan group in Asia as well as from the Semitic have come great religions. The Persians developed Zoroastrianism, based upon the principle of the conflict between good and evil; and the Hindus originated Brahmanism and its outgrowth, Buddhism, which between them now number perhaps 350,000,000 followers in Asia. From the yellow man, too, has sprung a great system, that which Confucius originated in the 5th century B.C. and which has been the religion of most of the Chinese ever since.

As a result, Asia contains places of pilgrimage for the whole world. Palestine has been sought by Christians since long before those medieval military pilgrimages, the Crusades. Every year hundreds of thousands of Mohammedans go to Mecca and Medina in the Arabian desert. It is part of the duty of every Mohammedan to go once in his lifetime to these places so intimately connected with the prophet of his religion. For Buddhists Tibet is a holy land, and "Dragon Lake," high in the Great Pamir, is supposed to be the holy of holies. For the Chinese, the tomb of Confucius is a place of pilgrimage.

How Long Have We Known Asia?

The name Asia is believed to come from a Hebrew root which means, like the Latin root of the word *orient*, "the east" or "the rising sun." And Asia contains the whole so-called Orient, near East and far East alike. For thousands and thousands of years the riches of Asia have poured into Europe—spices, incense, rubies, pearls, silks of wonderful colors, and muslins as fine as gossamer. Until 500 years ago these precious things from China, India, and southern Arabia came by way of the long patient camel trains that spent months, sometimes years, making their way through the deserts of Turkestan, Persia, and Arabia, to Asia Minor.

[illegible]

By comparing these maps you can see the effect of altitude, rainfall, and vegetation upon the distribution of people throughout Asia





After Vasco da Gama discovered the ocean route around Africa to India in 1497-98, part of the traffic was carried by sailing vessels. Within 50 years the Portuguese navigators had pushed still farther, to China and Japan, and had established a line of trading posts which amounted to a coastal empire. In the first years of the 17th century Holland, England, and

Despite this long familiarity with the products of Asia, and this history of active commercial relations, the country and the people have remained unknown to us almost down to our own day. Missionaries going to India and China found people who had been doing things the same way for so many thousands of years that it was almost impossible to teach them any

A CARAVAN IN THE DESERT



In the desert regions of Asia, as in those of Africa, the camels are still and long will be the chief means of moving passengers and freight. Here we see a caravan lumbering along what is evidently a pretty well traveled road. Under ordinary circumstances 25 miles a day is a good average pace for a caravan. Notice the sparse desert vegetation in the foreground.

France had also their commercial companies in the far East. Just before the middle of the 18th century there began a 40 years' duel between England and France for the supremacy of southern Asia, England at length coming out victorious. In the meantime Russia had started across Siberia in 1580, and within 80 years had obtained this largest slice of Asia to the Pacific Ocean and the Amur River, unopposed by the rest of Europe and weakly questioned by the Turk.

In the 18th and 19th centuries American clipper ships from Salem, Boston, and Providence did a flourishing trade in tea, coffee, ivory, spices, and fine fabrics, and it was an American, Commodore Perry, who opened the doors of Japan in 1854, after they had been closed to the western world for a century and a half. A war between China and Japan in 1894-95 resulted in the cession of Formosa, or Taiwan as the Japanese call it, and Pescadores to Japan, and the Russo-Japanese War in the cession of the southern half of the island of Sakhalin to Japan in 1905, while Korea was annexed to the island empire in 1910. The Philippines were transferred to the United States at the close of the Spanish-American War in 1898.

In the last decade of the 19th century various attempts were made to shorten the distance between Europe and Asia. The Suez Canal was dug, connecting the Mediterranean with the Red Sea so that ships could go through to the Indian Ocean without rounding Africa. Russia built railroads across Siberia and Central Asia, and Germany was busy with a project more momentous still, a railway from Hamburg to Bagdad—and perhaps beyond.

other way. Nor could the bustling West understand the viewpoint of people whose minds seemed to work in set grooves.

What of Asia's Future?

But the enterprise of the modern world could not allow one-third of the land of the globe to remain closed to it indefinitely. The wealth of Asia in terms of natural resources and cheap labor—the average income in India is only \$20 a year, and for China it may be even less—tempted the modern world to conquest just as the gold and jewels tempted Alexander. England and Russia each had an excellent foothold, France and Holland smaller, but equally definite and profitable holdings, and Germany arriving late on the scene sought to supplement her strategic foothold in Shantung by means of the Bagdad railway and her influence through Turkey upon Asia Minor. The rivalries, at bottom commercial, for the unexploited Asiatic lands made them stakes for which a dangerous diplomatic game was constantly played.

What the map of Asia will be after things have shaken down hardly anyone dares to speculate. People used to wonder whether the future of Asia was to be yellow or white. But the experience of Japan in attempting to dominate China would seem to show that the oriental nations get on better with the occidentals than with each other, and that any widespread union among the Asiatics themselves is unlikely. The questions that now arise are smaller ones. With Russia out of it what will England's policy be in India and on the Indian border? What is to become of separate parts of the Russian empire in Asia? What is to become of China? An independent kingdom of the Hejaz has been formed in Arabia. Will

Persia really be free at last? And are the troubles of Armenia at an end? For 20 years Asia had been shaking off its apathy and the World War has hastened the day of its awakening. Its future is one great question mark. (See also articles on the separate countries, cities, and chief physical features.)

ASIA MINOR. The name Asia Minor has been applied since the 5th century B.C. to that great peninsula which juts westward from the continent of Asia, separating the Black Sea from the Mediterranean and facing Europe across the Dardanelles, the Sea of Marmora, and the Bosphorus. On the east it is bordered by Mesopotamia and Armenia. In modern times the name Anatolia, meaning "the East," has been given to this great region. Its area is about twice that of New York, New Jersey, and Pennsylvania put together.

Asia Minor consists mostly of a high and barren central plateau, fringed on all sides by rugged mountains, including the great Taurus range to the south. Only on the slopes between the mountains and the sea do forests and green fields now thrive, though in ancient days, before it was stripped of its trees, it was fertile and well watered.

This country has been the battle ground of warring nations since the days of ancient Troy, which stood near its extreme western tip. It was the home of the Hittites of the kingdoms of Phrygia and Lydia, and of important Greek colonies along the coast. It saw the victorious armies of Croesus and of the Persian kings, the famous "March of the Ten Thousand" described by Xenophon, and the conquests of Alexander the Great and of Rome. Finally, beginning in the 11th century, it passed gradually into the hands of the Turks, who, after staggering beneath the blows of the wild Tamerlane, established the rule which continues to this day.

Asia Minor possesses tremendous undeveloped mineral wealth, extensive forests, and many fertile valleys. But its greatest political importance arises from the fact that it is the natural highway between Europe and southwestern Asia. As such, it was one of the underlying causes of the World War of 1914-18, for German influence had become so strong in Turkey that the German Empire had obtained almost complete control of Asia Minor as a military and trade route, centering about the famous Bagdad railway.

ASPARAGUS. When allowed to mature, the tall plumelike branches of the cultivated asparagus are as beautiful as a delicate fern, with the added splendor of numerous red berries which glisten amid the feathery foliage. And what table vegetable is more toothsome and healthful than these same luscious shoots, if cut when they first poke their purplish-white caps through the rich bed in which they grow?

Yet the wild asparagus, as it grows on the southern coast of England, is an insignificant plant, with branches only a foot high and stems no thicker than a goose quill. On the plains of Russia the wild varieties are so plentiful that cattle eat them like grass.

For 2,000 years asparagus has been cultivated for the table; for it was a favorite vegetable with the ancient Romans. It is a perennial plant and early in the spring sends up its thick tender stalks, which are ready for cooking when six or eight inches high. The plants are grown in rows set two and one-half to five feet apart, and with one to two-foot intervals in the rows. Beds once established bear for years, but require heavy manuring. Usually the rows are banked with earth to "blanch" or whiten the stalks. Asparagus is canned in large quantities, especially in California.

There are 150 species of asparagus widely distributed in tropical and temperate countries. Many species are cultivated only for ornamental purposes, some reaching a height of 15 feet. The common smilax is a close relative. Scientific name of common garden variety, *Asparagus officinalis*.

OVERLOOKING THE PITCH LAKE



Here we see a picture of part of the great pitch lake of Trinidad, with the little railroad that carries the black freight to the shipping point.

ASPHALT. "What other mineral can you name," asks a scientific writer, "which, when a wagon-load is taken away, accommodatingly fills up the hole by itself, so that there is just as much of it as before?"

This is the situation with reference to the famous asphalt deposits in the British island of Trinidad, just off the mouth of the Orinoco River in South America. These are chiefly in the form of a lake of

GATHERING THE INEXHAUSTIBLE HARVEST OF PITCH



Here is a closer view of the black lake with the black workmen digging out the asphalt in blocks. No matter how much is taken out during the day the holes dug are filled up by the next morning.

asphalt about one mile in diameter, occupying the crater of what seems to be an extinct mud volcano. The supply partly renews itself by a constant flow of soft pitch from subterranean sources. Nature seems also to say, "Let's make it handy"; for this asphalt lies near the sea, is right on the surface so that no mining is required, and is so pure that it requires almost no refining. The deposit is owned by the British government, but is leased to an American company. More than 85 per cent of the asphalt used in the United States has come from this lake.

In the nearby state of Bermudez, Venezuela, is another asphalt lake, covering 1,000 acres, and Cuba also yields a considerable supply. In California beds of very pure high-grade liquid asphalt are found, which even in its natural state has the proper consistency for paving. Other producing states are Kentucky, Texas, Oklahoma, Colorado, and Utah. Deposits also occur in Canada and several countries of Europe. Recently the manufacture of asphalt from petroleum has also become an important industry.

Raw asphalt is manufactured into a cement by melting and mixing it with other forms of bitumen. Clean sharp

sand heated to 300 degrees is added, and lastly carbonate of lime. The three substances are mixed thoroughly and the product is the mixture used for paving streets. Asphalt is employed also for making black Japan varnish, roofing felts and waterproofed paper, and for waterproofing foundations or bridges and buildings.

Asphalt is a solid or semi-solid form of bitumen, black or brown in color, brittle in consistency (though this varies from a bright pitchy condition to thick masses of mineral tar), and compact. It melts easily at about the boiling point of water, and emits a thick smoke of pitchy odor.

Nearly all geologists agree that asphalt is derived from fatty and oily accumulations from both animals and plants at high temperatures and pressures.

ASS. The patient ass is a far older friend of man than the horse, for it was captured in the deserts of Egypt and western Asia and domesticated long before the horse had been first subdued in his northern grasslands.

THE WILD ASS OF THE BIBLE



Here is a picture of the wild asses of Asia, so often referred to in Scripture; for example, Num. xxii, 28; 2 Pet. ii, 16, and Job xxxix, 5.

Wild asses still flourish in the Nubian deserts and the arid interior of Asia, where we find the nimble kiang and onager of Eastern Mongolia and Tibet. Travelers tell us that those who have seen the donkey only in its civilized state have no conception of its wild ancestor. For the latter is one of the fleetest of animals, the perfection of activity and courage,

and high-bred in every act and step. The domestic ass or donkey is descended from the African ass of Abyssinia. It is smaller in size than the horse and has long hair only at the end of its tail. Its color is usually gray.

The reputation of the ass for stupidity is very old. Even the Egyptians represented an ignorant person by the head and ears of an ass. In the Middle Ages the Germans represented Thomas, the unbelieving apostle, by the ass, and the boy who was last to enter the school on St. Thomas' Day was called the "Ass Thomas." In northern France the "Feast of the Ass" commemorated the Flight of Mary and the infant Jesus into Egypt; Balaam's ass also appeared and uttered prophecies. Because of abuses this festival of the church was suppressed in the 15th century.

In southern Europe the ass has been carefully bred and thus greatly improved. In Kentucky and Missouri, where they are used in breeding mules, as a result of good care they are above the average in size. In the north of India, where they are used by the lower castes, they are little taller than a Newfoundland dog.

In Syria and Egypt the ass is seen at its best, and is highly prized as a domestic animal. Its milk is used for food and is especially good for invalids. The leather called shagreen is tanned from the skin of the ass.

ASSASSINS. Near the end of the 11th century a Mohammedan named Hassan ben Sabah established himself in a mountain fortress of Persia. This became the headquarters of a secret Mohammedan sect, which for two centuries spread the terror of its name from India to Egypt. Instead of fighting his enemies in battle, Hassan resorted to secret murders, planned and carried out with great skill by his numerous followers.

The "Old Man of the Mountain," as Hassan was called, demanded blind obedience from his followers. This he obtained in a strange way. He maintained beautiful and luxurious gardens, carefully guarded, into which he introduced his disciples, after giving them a heavy dose of a dream-producing drug called *hashish*, made of Indian hemp. The next day, the young men were told that the magnificent visions which they could faintly remember were a foretaste of the heaven which awaited them if they obeyed their leader. They were then sent forth on their murderous missions. This use of hashish won for the members of the sect the name of *Hashishins* or "Assassins," a name which came to be applied to all political murderers.

The title of the Old Man of the Mountain passed down through a long succession of chieftains. The Assassins were compelled to move their principal stronghold from Persia to Syria. It was here that they clashed with the Crusaders, making their sinister power felt by the secret slaying of several of the European leaders. But men trained in murder cannot live in peace among themselves, and it was not long before the Assassin leaders began practicing their art on each other. Their power waned, and in 1255 the Tatar prince Hulaku massacred 12,000 of the hashish eaters and put an end to their rule. Small tribes still linger in the Syrian mountains, who claim the questionable honor of descent from the Old Man of the Mountain.

ASSAYING. To find out how much of a given total there is in a metallic ore or alloy—such as the amount of iron in a specimen of iron ore or the amount of silver in a silver dollar—we go to the assayer. Assay processes vary with different metals, but the method used with silver ore will serve as an illustration.

The first process is called scorification. One part, by weight, of ore is mixed with from 10 to 20 times its weight of granulated lead and half its weight of borax. This mixture is put in a crucible or in a fire-clay dish, called the "scorifier." It is then heated to redness in a furnace having a compartment or muffle open to the air, until the substances are thoroughly melted. The surface of the molten lead now shows in a circular space in the center of the scorifier, while the earthy materials are seen as a "slag" which forms a ring around this circle. The heating is continued until a considerable part of the lead has been oxidized to lead oxide. This goes into the slag and increases its amount, so that the slag finally covers the diminishing metallic lead. Then the melted mixture is poured into a mold, and, on cooling, a lead button is seen which can be detached from the slag. The lead has taken up the silver as well as any gold that may be present.

The next process is called *cupellation*. The "cupel" is a small porous cup made of burnt bone. The lead button is put in this vessel, after the latter has been heated to redness in a muffle furnace. The lead and other base metals that may be present are burned or oxidized, and the oxides are absorbed by the porous mass of the cupel, or sent off in the shape of vapor. Silver and gold are not oxidized, hence they remain in the metallic state. Just before the assay is finished, rainbow colors come and go over the button, and a brilliant flashing up of color marks the end of the operation. The silver button left in the cupel is finally weighed and the yield of the ore is computed.

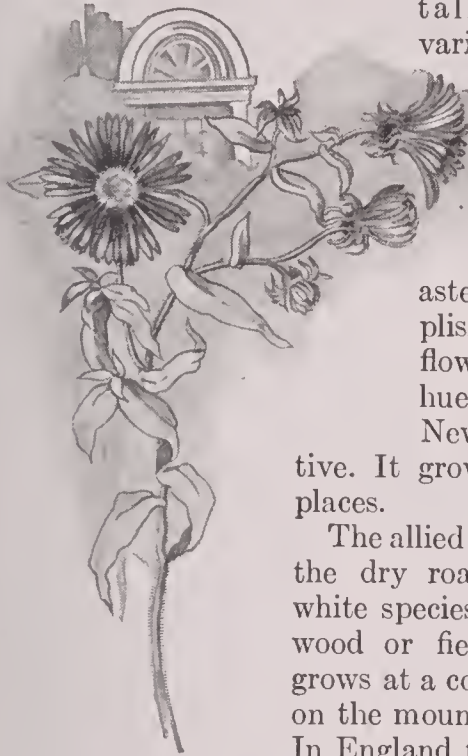
ASSYRIA. The second of the three great Semitic empires that grew up in the Tigris-Euphrates valley in ancient times is that of the Assyrians, who dwelt about Nineveh in the upper part of the Tigris valley. The Assyrians were closely related to the Babylonians in race, language, and culture, and the history of Assyria is closely intertwined with that of Babylonia. (See Babylonia and Assyria.)

ASTER. Toward the last of August and throughout September and October, these beautiful starry wild flowers clothe the land in royal bloom and add much to the charm of the American autumn. The aster (from the Greek *aster*, meaning "star") was so named because of its radiating or starlike flower head, which varies from a half-inch to nearly two inches in diameter. It belongs to the family of plants having composite blossoms—such as the marigold, daisy, dandelion, and others—and is found largely in North America, though some species grow in almost every region of the globe. In the United States over 250 species of wild asters bloom with such profusion that the aster has fittingly been suggested as

the national flower. Big and little, short and tall, ragged and tidy, they spangle every roadside, fence-row, meadow, and hillside—

And everywhere the purple asters nod
And bend and wave and flit.

The purple or blue asters are very numerous, ranging from the low-growing seaside plant to the tall New England variety which reaches



sometimes eight feet in height. One of their prettiest species is the late purple aster, with its purplish-blue daisy-like flower heads, paler in hue than those of its New England rela-

tive. It grows in dry exposed places.

The allied golden asters seek the dry roadside, while the white species appear in open wood or field. One variety grows at a considerable height on the mountains of Europe. In England the aster is called

the Michaelmas and Christmas daisy, because when the weather is mild it blooms until Christmas day.

The cultivated aster in our gardens is usually called the China aster because it is a native of that country. It yields a great variety of blossoms almost twice the size of the largest wild aster. Its colors range from white and blush through rose and crimson; and from lilac through blue to purple.

Family name of the aster, *Asteraceae*. The New England aster (*Aster novaeangliae*) has flowers 1 to 2 inches across, which grow in branching clusters. They have from 30 to 40 violet or purple ray florets surrounding numerous 5-lobed, tubular yellow disk florets, set in a sticky green cup. The stem is 2 to 8 feet high, rough, stout, and leafy. The leaves, growing directly from the stem, are long, lobed at the base, and pointed at the tip.

ASTEROIDS. The baby planets of the solar system, most of which occur in the so-called "gap" between Mars and Jupiter, are called "asteroids" or "planetoids." More than 800 of these have been discovered and photographed, and it is quite probable that the number ultimately found will run into thousands. There may be countless others so small as to remain forever invisible. Even the largest can rarely be seen with the unaided eye.

The existence of such planet-like bodies was unknown until Piazzi, an Italian astronomer, discovered Ceres, the largest of them, with a diameter of 485 miles, on New Year's Day, 1801. The next largest are Pallas (304 miles in diameter), Vesta (248 miles), and Juno (118 miles). The faintest so far found probably do not exceed five miles in diameter.

If the entire solar system were arranged symmetrically according to what is called Bode's law, the region where these bodies are found would be occupied by a large planet. A theory has therefore been put forward that these asteroids are fragments of such a planet which was broken up by a celestial catastrophe. But modern astronomy rejects this explanation, and regards the asteroids as the fragmentary materials or "planetesimals" out of which a large planet would have been built up if there had been any predominating nucleus or center of attraction within the zone (see *Nebulae*).

The asteroids move in orbits around the sun just as the earth and other planets do. Their periods or length of revolution are from three to ten years. Their orbits are generally very elliptical, one end of the orbit being much closer to the sun than the other. At least one of the asteroids, Eros, has an orbit of such size and shape that when the little planet is near the sun, it comes inside the orbit of Mars. It is especially interesting to astronomers because of all the heavenly bodies, except the moon, it comes closest to the earth. Once in 27 years it approaches within 13,000,000 miles of us, which is really "just across the street" in comparison with the size of the universe. Observations of the parallax of Eros give the best method of determining the extent of the solar system, and therefore its discovery is ranked among those of special importance. It was found by the astronomer Witt of Berlin in 1898. (See also *Astronomy*; *Planets*; *Sun and Solar System*.)

ASTRAKHAN (ăs-tră-kăn'). You have often seen the beautiful curly glossy-black fur called "astrakhan." Did you ever stop to think where it comes from and how it gets its name?

Astrakhan fur is the skin of new-born Persian lambs, and it gets its name from the city of Astrakhan, the most important commercial center on the Caspian Sea. The city, which is about the size of New Haven, Conn., is a picturesque but filthy semi-oriental town, built on an island in the Volga River, 60 miles from where it empties into the Caspian Sea. For centuries it has been one of the chief meeting places of Europe and Asia. Through it pass every year many millions of dollars' worth of gold, silks, embroideries, spices, drugs, and grain, which the nations of Central Asia exchange at Astrakhan for cotton, leather, dry goods, salt, sugar, and other products. Among its most important exports also are petroleum from the great nearby wells of Baku, and fish from the Volga.

The government of Astrakhan, of which this city is the capital, was the fourth political division of Russia in point of size. After the World War of 1914-18 it became a part of one of the many fragmentary republics erected on the ruins of Russia. The district occupies an area of about 91,000 miles on both sides of the Volga and on the shores of the Caspian. Except along the river the region is a vast arid steppe. Fishing, cattle-raising, and salt-making are almost the only industries of its varied population—composed of Russians, Tatars, Kalmucks, Armenians, Poles, Georgians, and Bokharese.

LIKE A MOUNTAIN TUMBLING THROUGH THE SKY



You probably think of all the planets as nearly round in shape, but now astronomers tell us that the small planet or asteroid called Eros is a rough irregular mass like a huge mountain. Some believe that others of these tiny worlds are also irregular in shape, because they haven't sufficient mass to give the gravity—the pull toward the center—necessary to draw them into roundness. Notice the exceptional orbit of Eros, pictured in the corner, which lies partly within the orbit of Mars, as explained on p. 237.

For any subject not found in its alphabetical place see information

The WONDROUS SCIENCE of the STARS

ASTRONOMY. The earliest man and the simplest savage could not escape some thought about things in nature, the earth under his feet, the waters and the winds, animals and plants, and the heavens above his head. The changelessness of the ever-changing sky did not escape the gaze of the early shepherds on the hills, of the primitive mariner or hunter who guided his course by the stars, and of the plowman who planted and harvested at the will of sun and moon. Everything in life about primitive man on land and water, his waking and his dreaming hours, all seemed in some mysterious way to obey the voices of the heavens, to change with the shifting stars and moon and the sinking and rising sun. Is it any wonder then that the study of astronomy goes back to the earliest times and that its scope is as broad as the universe?

The ancient Greeks, without telescopes or modern instruments, obtained a surprising knowledge of the heavens; but they owed a great debt to still earlier peoples, the Chaldeans and Egyptians who lived in the valleys of the Euphrates and the Nile. It is told of the early Greek astronomers that they used to go to Egypt, where the science of the stars was jealously guarded by the priests, to learn the secret of determining the number of days in a year.

Without a considerable knowledge of the heavens, our remote ancestors could not devise the simplest calendar to foretell the seasons. More important still, they could not navigate the seas. To astronomy we owe the first voyages of the Phoenicians, and to astronomy in later times we are indebted for the discovery of America.

HOW wonderful are the Heavens, whose glory sparkles above us in the silent night! And how amazing is the knowledge which the Science of Astronomy enables man to wrest from them—of the Sun, Moon, and Planets of our own Solar System, of wandering comets and misty nebulae, of the size and constitution and enormous number of the fixed stars—the nearest of which is so distant that its light takes three years to reach us, while others are so remote that rays now coming to the Earth started on their rapid journey some 200,000 years ago!

More than a century before the Christian era the Greeks were familiar with the apparent uniform motion of the fixed stars and the variable motions of the planets, and with the idea that the earth was a sphere. They knew how to measure latitude and longitude and how to foretell eclipses; they had determined the fact and effect of the precession of the equinoxes, a discovery that is the more remarkable when we realize that the so-called "precession" alters the time of the equinoxes (roughly, the beginning of spring and fall) by only a few minutes each year (see Equinox and Solstice). One of the greatest of these early observers was Ptolemy, the Greek astronomer and geographer, whose books were the standard sources of information for over a thousand years. His chief astronomical error was in believing that the earth was the center of the heavens, and that the sun, planets, and fixed stars revolved around it.

The modern science of astronomy begins with Copernicus (1473-1543) who first saw that it is the sun, and not the earth, that is the center of what we now call the "solar system." Other observers confirmed this theory. The next great advances were due to the invention of the telescope in the 17th century, and the discovery of the law of gravitation by Sir Isaac Newton.

The telescope immensely increased our powers of observation. But the progress of the science would be slow if observation were not coupled with a corresponding effort to discover and apply, by means of interpretation, the underlying laws of the heavens. Newton's discovery was a great triumph of interpretation. Galileo first found the satellites of Jupiter,



HOW TO FIND YOUR WAY BY THE STARS

If you should be lost at night, would you know how to find your way? Down in the kindergarten the little tots sing a song:

"This way's east and this way's west,
Soon I'll learn to know the rest."

They do learn, too. They learn that if one stands with the right hand pointing to the morning sun, one faces north, and the back is to the south. But they do not learn, until they are much older, and sometimes not at all, how to find their way at night. And it's worst of all to be lost at night, too. Very high in the sky, on clear nights, is always to be seen a certain group of bright stars. There are seven stars in the group, and they make a very big dipper with a handle. Four of the stars form the bowl, two at the top, two nearer together at the bottom. The other three stars make a handle for the dipper. The last star is lower, giving a bend to the handle. Now, you must fix your eyes on the two stars that form the outer line of the dipper's bowl, from the bottom to the top. Imagine a straight line connecting those stars. Extend that line upward in the same direction until it runs into another bright star. That is the north or polar star. Face toward the polar star and you will be looking almost due north. For many hundreds of years sailors guided vessels over wide seas by this polar star. So don't you think it might be useful to a lost child?

but he did not know why they revolved around that planet instead of flying off into space; Newton supplied the explanation. But a knowledge of laws such as Newton's does more than merely explain what has already been observed. They enable the astronomer to make new discoveries and to predict the changes in the heavens thousands of years in advance.

The Thousands of Suns We See at Night

As a result of astronomical discoveries our conception of the universe is vastly different from that of our ancestors. We know now that the sun, upon which we depend for our daily existence, is simply one among millions of the fixed stars, and that practically every star we see on a clear night is likewise a sun and may be surrounded by planets such as the earth (*see Earth; Star; Sun and Solar System*).

We know that the earth is only one of the eight chief *planets* which revolve about the sun, the whole comprising what we call the solar system. To the naked eye the planets have the appearance of stars. They are infinitely smaller, however, and are especially distinguished by the fact that they radiate no light of their own, but shine with the light they reflect from the sun. Within the solar system there is a group of similar bodies, much smaller in size, called "asteroids" or "planetoids." The moon is a satellite which revolves around the earth (*see Asteroids; Planets*).

Now and then this orderly system of sun and planets entertains visitors who come from we don't know where and seem quite out of place in our planetary family. These stray bodies we call comets, from the Greek word meaning "hair" for the reason that they resemble a star with a hairy tail. They come into the range of our vision for at most a few months, and then leave it again—some of them never to return (*see Comets*).

A Star Apiece for All of Us!

If by means of an airplane we could travel out into space at the same speed as light, that is at the rate of 186,330 miles a second, we should reach Neptune, the farthest planet, in about four hours. But to reach the nearest fixed star, Alpha Centauri, would require more than three years. From some of the more remote, astronomers calculate that light rays are now reaching us that started 200,000 years ago! This gives some idea of the enormous distances which separate our solar system from the stars we see in the heavens.

No one pretends to know how many stars there are, but astronomers of the royal observatory at Greenwich, England, have estimated the number to be between 770,000,000 and 1,800,000,000. If the latter figure is correct it means that there are just about as many stars in the heavens as there are people on the earth. Through the use of the telescope it has been found that a great number of stars are really double; that is, they consist of two stars revolving about each other, though to the unaided eye they look like one.

Of special interest to students interested in the evolution of the stars and the origin of the solar system are numerous bright objects, each of which has the appearance through the telescope of a small bright cloud or patch of light. Such a body is called a "nebula," from the Latin word meaning a "small cloud." Nebulae have many different shapes, some irregular, like the great nebula in the constellation Orion, and some spiral, the latter being regarded by some astronomers as the type of nebula from which the solar system evolved. The nebulae are undoubtedly composed of gases, including hydrogen and probably helium; and the idea has been advanced by some that they represent the fixed stars in the early stages of their development (*see Nebulae*).

What is a "Shooting Star"?

Besides the bodies already described, everyone has seen the bright moving flashes in the heavens which we incorrectly call "shooting stars." Instead of being stars, many of these objects are so small that they could be held in the hands. They are in fact mere fragments or particles of stars, properly known as meteors, which burn to a white heat when they come in contact with the earth's atmosphere. One theory is that they are caused by the breaking up of comets. Such fragments as fall to the earth from time to time are called meteorites, and are commonly composed of stone or iron (*see Meteors and Meteorites*).

It is evident that astronomy is far from a completed science, though in 1844 Auguste Comte, the French philosopher, asserted that all had been learned about the stars that could be learned and any more study was just a waste of time! Just a few years afterward the invention of the spectroscope opened up an entirely new field and made it possible to make discoveries that Comte regarded as utterly beyond the range of human knowledge. With the spectroscope, which is an instrument constructed on the principle of the prism, astronomers have been able to discover a great number of the substances that compose the sun and stars; they are certain, for example, that the sun contains such elements as hydrogen, oxygen, helium, copper, iron, silver, and lead, as well as a number of elements of which we have no knowledge on the earth. The spectroscope is also used to determine the motion of the stars in respect to each other, especially when they are moving to or from the direction of the earth (*see Spectrum and Spectroscope*).

Photography has likewise been of immense service to astronomy, making it possible to record heavenly objects with the greatest accuracy. For many years the principal observatories of the world have been engaged in photographing the entire heavens, and the completed work will consist of more than 22,000 separate plates or photographs, showing in all about 8,000,000 stars.

Practical Uses of Astronomy

We no longer believe, as did the old astrologists, that the motions of the stars and planets exercise some

THE WONDERS OF ASTRONOMY AND SOME OF ITS USES

SATURN
a planet
having 8
moons



SUN
Only one of
millions of similar
suns. Composed of hy-
drogen, oxygen, helium
copper, iron, silver,
lead, and other
substances

FIXED STAR
so far distant
from the earth that, though it
moves with terrific speed, it
appears stationary

DOUBLE STARS
revolve around
each other and
appear as one

NEBULAE

stars
in early
stages of
development. Composed of gases

METEOR
(Shooting Star)
a small heavenly body made white
hot by its flight through the earth's
atmosphere



EARTH
a sphere

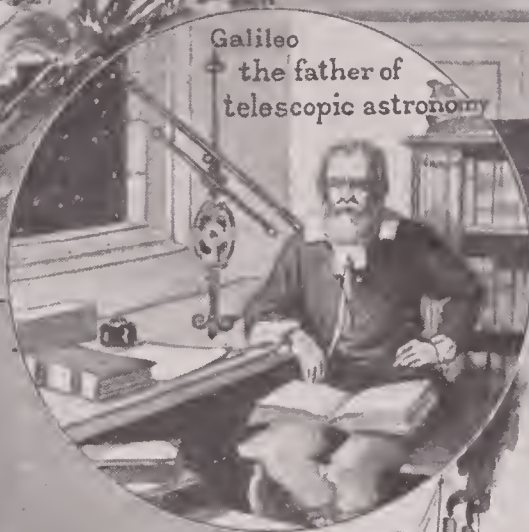


MOON
a dead
satellite
of the earth

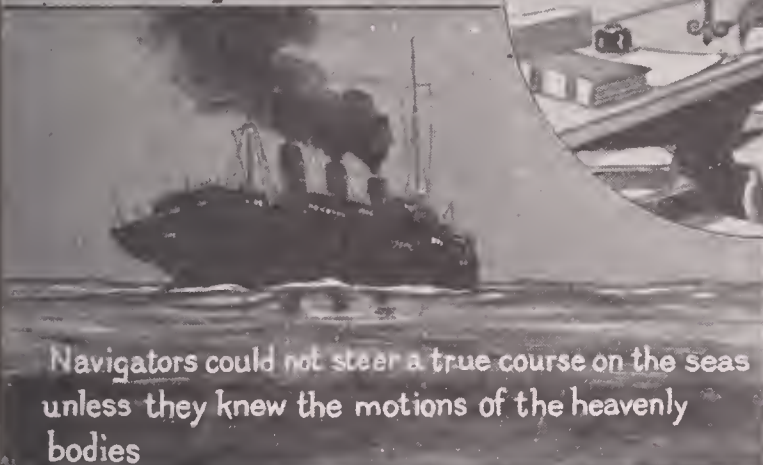


The discovering and charting
of strange lands

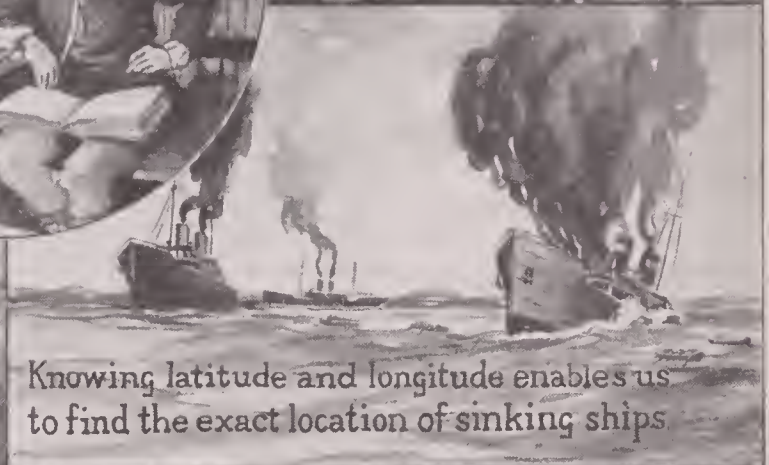
The measurement of time, without which
modern business would be impossible



Galileo
the father of
telescopic astronomy



Navigators could not steer a true course on the seas
unless they knew the motions of the heavenly
bodies



Knowing latitude and longitude enables us
to find the exact location of sinking ships



Astronomy has given us a
knowledge of the tremendous
vastness of space



It enables us to figure, centur-
ies in advance, the exact
moment of future eclipses and
other heavenly phenomena

We no longer believe in Astrology, but just look how much the stars have to do with the affairs, the great affairs, of men; the discovery and charting of new worlds, the measurement of time, navigation upon the world's wide waters, and the rescue of ships in trouble. In the center is a picture of the great Galileo, seated by a frame containing two telescopes of the early type. The larger of the two is about the size of the instrument with which he discovered four of the moons of Jupiter.

contained in the *Easy Reference Fact-Index* at the end of this work

mysterious influence on the fortunes of men or the course of human events; nevertheless astronomy has very important practical uses. We do not obtain correct time from watches or "regulators," but from the stars. In the United States the time observations are made at the naval observatory at Washington, and every noon the correct time is flashed by telegraph to all parts of the country. Just as Columbus looked to the stars to guide him to the New World, so the ship captain of today must look to the heavens in directing his course out of sight of land. Navigation is, in fact, a branch of astronomy; and one reason why all great countries have national astronomical observatories is the aid which they furnish to maritime commerce. Astronomy has likewise supplied the

fundamental facts for such sciences as meteorology or the science of the weather, and geology. Geodesy, the science which measures and surveys the earth, also depends largely on astronomy for its methods.

The future of astronomy of course cannot be predicted, but astronomers admit that they have only begun to explore the wonders of infinite space. Enormous as our solar system is, the starry heavens within the range of modern telescopes constitute a field of study millions of times greater, and for an astronomer the exploration of this vast area with its hundreds of millions of suns has all the romance and excitement of a journey to the source of the Amazon or an expedition to the North Pole. (*See also Observatory; Telescope.*)

The Boundless Universe

THE imagination of men goes out beyond the power of words to follow it when it soars into the universe. We live on our little Earth, which is part of the Solar System, but beyond the Solar System are immensities of space above conception.

We take our Solar System, the system revolving round our Sun, and even here the facts are staggering beyond all understanding; but the truth is that in the boundless universe the Solar System is like a grain of sand upon the seashore. The Sun is about 866,000 miles across, with a mass about 332,000 times that of the Earth, and it is nearly 93 million miles away from us. Round him swing eight planets—Mercury, Mars, and Venus, smaller than the Earth, and Jupiter, Saturn, Uranus, and Neptune, immensely larger than the Earth; and the distances of these planets from the Sun vary from 36 million miles in the case of Mercury, to 2,750 million miles in the case of Neptune.

Worlds Beyond Worlds, and Still More Beyond

Truly, as Lord Tennyson said, the thoughts of men are "widened with the process of the suns." It was not so very long ago that Saturn was the farthest thing we knew anything about in space—Saturn, with that marvelous ring of millions of tiny moons encircling it, incomparably the grandest spectacle to be seen in the heavens. Saturn is about 886 million miles from the Sun, and it represented the limits of the Solar System until about a century and a half ago. But then Uranus was discovered, nearly a thousand million miles beyond it; and then men turned their eyes on Neptune, a thousand million miles farther still. That is how the map of the Solar System has widened since the telescope revealed the heavens to us; and beyond the bounds of the Solar System the same thing has been happening. Outside this system lie millions upon millions of mighty worlds, swinging about in space, and the more our knowledge grows the more the wonder of the universe grows too.

Let us try to realize something of the wonder in the midst of which our Earth is set. If it is beyond

the power of words to describe, it is beyond the power of the human mind to understand the glory of the universe. The plain truth of it, the simple statement of its vastness and power, is beyond the wildest reach of our imagining. We look up at the stars by night, and the stillness of the skies seems a wonderful thing; but it is more wonderful than we know, for the stars whirl about with unthinkable speed, dazzling space with their light for thousands of millions of miles. Nothing that we know moves anything like so fast; no light that we have ever seen is anything like so bright. One small star among them is a laggard, creeping through space at 43,000 miles an hour, and attending on his round is a tiny globe a million times smaller, lit up with the light of the laggard star.

That laggard is the Sun, and the little globe is the Earth!

The Earth sweeps round the Sun in an orbit 180 million miles across. If the Earth were big enough to fill this orbit, instead of being so small that it is almost lost in it, it would still need over a million earths like that to match Orion, a fragment of the Milky Way.

The group of stars we call Orion is hundreds of millions of times as big as the Earth; they are so far back in space from us that we see the stars as mere dots of light. Try to let the mind run back to them, and we are lost in the depths of a universe that no man knows. The space the Solar System occupies is said to be a thousand million times greater than the volume of the Sun and all the planets. One of the smallest of the stars, a sort of atom in the universe, smaller than any star we see by night, is our Sun. But it is all the world to us, because it is so near. It is hardly a hundred million miles away; and to this nearness of the Sun we owe our habitation on this Earth, the produce of our fields and gardens, the power that moves our guns and lights our homes, and the beating of the heart of every living thing.

Let your mind run back only to the Sun—like a run up a street as distance goes in the universe—

and how many stars would you find there, keeping the Sun company? Draw a circle about the Sun 300 million million miles round, and in it there would be four other stars. If a man were living in New York and his nearest neighbor were in Tasmania, he would probably yearn for company; but compared with the loneliness of our universe, a world peopled at that rate would seem crowded like pebbles on the beach! The Solar System in which our Earth revolves is 6,000 million miles across; and yet this system, with all the worlds that come into our view as the year goes round, is a lonely thing, immensely isolated in space, cut off from other groups of worlds more utterly than any two people could possibly be if they two were left all alone upon the Earth.

How vividly, as we think of these things, we realize that the affairs of the United States, the history of the World War, and even the whole Earth itself, are like the flickering of a candle in the vast immensity of all God's boundless worlds.

Think what the Earth is; then remember that it is like a dot in the whole Solar System. Farther and farther out our knowledge of the Solar System goes. Not long ago, as we have seen, we found a world that lies a thousand million miles beyond anything we knew, and it is almost certain that we shall find another world—or other worlds—beyond. Inside this Solar System roll Earth's neighbors—those other children of the Sun that we call Mars and Mercury and Venus and Saturn and Jupiter and Neptune and Uranus; and the vast space they move about in, the space inhabited by our Sun and his family of planets, is as far across as two million earths would be. We cannot even conceive what that means. We begin to understand what the French philosopher Pascal meant when he said that the eternal silence of these infinite spaces made him afraid.

We see, then, that the Earth is a dot in the great Solar System, but what shall we say of that system itself? *It is just another dot in the universe in which it moves!* It is beyond our power to understand it at all; we can only think of it and wonder more and more. We look up at the group of stars we call Orion, so quiet and glorious up there in the sky, and these

stars are hundreds of million times as big as our Earth. It is said that if we took the Sun and all its planets, and made them into one huge ball, it would take a thousand million of these balls to fill the space the Solar System occupies.

Boundless beyond all thinking is the space that lies outside the path of all these swinging worlds. So great is distance in the heavens that we cannot measure it in miles; we count it, instead, according to

the distance light travels in a year. A ray of light will travel in one year just over 5,840,000,000,000 miles and that is the distance we mean every time we speak of a "light-year." Well, so far as men can measure it, the bounds of the universe were reckoned a few years ago to be *not less than two thousand light-years away*; that is, a great deal more than ten thousand million million miles. It may be said that that was the distance of the farthest thing we knew; and in a universe like that, the Earth is as a speck of dust, and the Solar System as a straw blown in the wind.

Far Greater than We Dreamed

But now, during the years of the World War, a new and astounding chapter has been added

to our knowledge of the universe beyond our Solar System. The universe in which the Sun, the Earth, and all the boundless realms of stars move on and on forever is even greater than we knew! We used to think its farthest limit perhaps two thousand light-years away; what we now believe is that it may be *two hundred thousand* light-years away. The ten-thousand-million-million limit that men had set to the outer universe has now become, let us say, a million-million-million limit! We may say that the new knowledge quietly accumulated in the world during the World War widened the bounds of the known universe one hundred times, so that the immensity of space, with all its myriads of worlds, is a hundred times greater than we dreamed of.

Of one great cluster of stars alone, the cluster of Hercules, we can photograph the light today which left the stars 36,000 years ago, when most of Europe was under ice; and so inconceivable is the size of this group of stars that a ray of light from a star on

SATURN AND ITS RINGS



Saturn, of all the worlds we know, is the only one that has rings around it. It is difficult to tell whether there are three or only two rings about the planet, as you can see. The rings are made up of an incalculable number of very small meteor-like particles.

one side of it takes 300 years to cross to the other side! Clearly, we can only suggest, in a short chapter such as this, what this boundless universe is known to be.

How do we know of all these wondrous things existing beyond man's sight or sound? It would take too long to tell the marvelous story of the great discoveries that men have made, but perhaps we may take one example of the way in which the explorers of the universe set out and reach their journey's end. Let us take perhaps the most amazing chapter in the whole history of astronomy—the discovery of Neptune.

Mystery of the Missing World

Once upon a time a world was missing from its place, so two men set out to find the reason. They found it. It was one of the greatest triumphs of the human mind. The world had left its calculated path. It had made a call on its way and it was late in arriving, and all the astronomers of the Earth were baffled. What could have happened to that world? *It had gone a little way to meet another world*, a thousand million miles beyond it, a world no man had ever seen, of which no man had ever heard; and when the secret was discovered, there was written one of the most amazing tales that has been put in a book.

It began long ago and far away; we must go back 50,000 days in time and thousands of millions of miles in space; and we must think of a little world that spins through space about 1,800 million miles away from us—a world not yet finished, scores of times bigger than the Earth, but not yet cool and solid, a sort of boiling vaporous mass 30,000 miles across, with a year as long as 80 of ours. It is called Uranus.

For centuries Uranus had been seen. Thousands of times the old astronomers of Assyria and Chaldea must have looked at it, but it was thought to be a star and no more. It was not till just over a century ago that Uranus was found to be a planet, one of the Sun's great families of worlds.

It lay far beyond the path of the most distant planet known. The universe beyond the orbit of Saturn was impenetrable darkness to man, except for the eternal movement of the stars. Saturn was the boundary line of knowledge. We knew there were worlds on *this* side of her path, but no man dreamed that there were worlds beyond.

Finding a World with a Home-made Telescope

It was an organist at Bath, in England, looking through his home-made telescope, who saw Uranus on March 13, 1781, and knew it to be more than a star. His name was William Herschel, the first modern man on earth to discover a planet. He could not know all that is known today from his discovery; he could not trace Uranus through the heavens and mark its track as we can do, for Uranus goes round the sun but once in a century. It takes 81 years to complete the journey round the Sun which our Earth makes between January and December,

and life is all too short for discoverers of worlds like these to complete their observations. But men may come and men may go, and their work goes on forever. Other men watched Uranus, other men marked its track, and there is not an hour of its journey since Herschel first saw it that has not been noted down. We know where it was on any day since it was found; we know where it was on any day before it was found; we know where it will be on any day in ten thousand years to come. The universe does not fail; its wheels go round while nations rise and fall and mountains crumble into dust.

Well, it was Uranus that had strayed from its calculated path. Every day and hour it had been watched since William Herschel found it. Every movement was recorded, that a history might be made of the full circle of its 81 years. Herschel's work on earth was ending, and Uranus was half-way round its circle. Then one day a French astronomer, keeping his time-tables of the worlds, found, in 1821, that Uranus was not where it should have been. He could not believe his eyes.

The Strange Conduct of Uranus

That world was out of its predicted place, and the watchmen of the skies were all bewildered. A train may be a minute late, a ship may be a day late, but these things do not happen in the universe. And Uranus continued to be late. The time-table that was wrong in 1821 was still wrong in 1830. Uranus was out of her path by 20 seconds in 1830, by 90 seconds in 1840, by 128 seconds in 1846. Nothing like this had happened in the memory of astronomy, and the wanderings of Uranus were the talk of observatories for a quarter of a century. Nowhere in the skies was anything more exciting. Something tremendous, something unknown, was happening somewhere. One of the greatest mysteries ever presented to the mind of man was awaiting his solution.

Remember that Uranus was the first planet the modern explorers of the skies had found. It had gone only half-way round its path when it was missed. It was expected to follow a particular path, according to all known laws; it followed the path for 40 years and then swerved outward. It had been doing that for millions of years and no man had seen it; and what was happening now, with the farthest world we knew leaving us to reach out farther still, was almost incredible to the men who were looking on. For behind this outward swerve of Uranus must be some momentous power. Till 40 years before, the path of Saturn was the boundary of our knowledge of the planets. But Uranus was as far beyond Saturn as Saturn was beyond the Earth; and what the swerve of Uranus meant was that there was something farther still, something perhaps as far beyond Uranus as Uranus is from Saturn.

It meant that this new world, more than a thousand million miles from the Earth, was pulled out by another world a thousand million miles farther still!

DISCOVERING A NEW WORLD BY MATHEMATICS



Professor J. C. Adams, one of the discoverers of Neptune, is here explaining to a friend the calculations by which he came to the conclusion that there was a new world to be discovered in the heavens at the point indicated by his index finger. You can see that this occurred back in the 1840's when men wore stocks and cutaway coats with double rows of bright brass buttons. In the background is the telescope used in the observatory of Cambridge University at that time, together with the chair where the observer sat to study the heavens. The telescopes we have in our observatories today are a great deal larger than this.

contained in the Easy Reference Fact-Index at the end of this work

HOW NEPTUNE INTERFERED WITH URANUS



It is hard to comprehend at first how Neptune could hurry Uranus forward in one part of its path through the sky and hold it back in another, yet when you examine this picture-diagram how simple it all becomes! You see, in one part of the orbits of the two planets Neptune is pulling forward like a boy drawing his sled up hill. The result is that between 1800 and 1810 Uranus moved along much faster than its ordinary gait, while between 1830 and 1840 conditions were just the opposite. By 1840 Neptune was pulling almost straight back on Uranus, which was trying as hard as ever it could to go on its regular round. It was this swerving of Uranus from its course that caused astronomers to believe that an unknown world was pulling it, and so led to the discovery of Neptune.

The bounds of space were widening fast. The discovery of Uranus was a triumph of knowledge, but something greater still was now to come, for the discovery of a world beyond it was a mighty leap of faith. If men tell you that faith is nothing, tell them that faith found Neptune, 2,750 million miles away. Long before the first telescope was turned towards Neptune, men knew that it was there. They saw it in faith as Columbus saw America from Spain. They saw it as Francis Drake, up a tree at Panama, saw his ship sailing the Pacific.

This mighty leap of faith that bridged a thousand million miles beyond the last milestone of knowledge was soon to be tested, and to be justified abundantly. Uranus was lost in 1821. Twelve years later it was suggested that there must be a disturbing body beyond it; 12 years later still the disturbing body was found. It was found by arithmetic. But for two

young men who were clever with arithmetic at school, we might never have known of Neptune. They knew there could be no other explanation of the swerving of Uranus except that an unknown world was pulling it. They knew when Uranus was pulled, and how far it was pulled; what was now to be worked out was the nature of the force that pulled it. It was just a question of arithmetic.

If a world of such a size, traveling at such a rate 1,750 million miles away, was 30 seconds late in arriving at a given point, what was the size and speed and distance and pull of the force that kept it back, and when would this unknown force arrive at a given point?

That was the problem two men set out to solve. One was French and the other was English, two mathematicians, neither knowing the other—Urbain Leverrier in France and Prof. J. C. Adams at Cambridge, England.

By one of the most astounding coincidences in the history of science, both these men, unknown to the other, set out to solve the mystery of Uranus by arithmetic. In October 1845, Professor Adams sent his calculations to Greenwich Observatory, where they lay unused for months, so that before Greenwich had tested them Leverrier published his figures. The two sets of figures were amazingly near to each other, and Professor Adams hastened to urge the Astronomer Royal at Greenwich to test his calculations.

That was on Sept. 2, 1846, and on Sept. 10 a great astronomer told the British Association that they were on the eve of the discovery of a world no man had seen. "We see it as Columbus saw America from the shores of Spain," he said. "Its movements have been felt trembling along the far-reaching line of our analysis with a certainty hardly inferior to sight."

The Hidden World that Did the Pulling!

Eight days after that Leverrier wrote to Dr. Galle, the astronomer at the observatory at Berlin, and asked him to turn his telescope to a particular spot in the sky. "There," he wrote to Dr. Galle, "you will see a planet which I have not seen, and which no human eye has ever seen; but it must lie in that spot, because calculations have pointed out the necessity for its existence." Dr. Galle had an accurate chart of the stars in the region Leverrier described. On Sept. 23, 1846, he turned his telescope to the spot and found a bright light that was not on his chart. It was Neptune, the most distant world we know.

That is how faith and arithmetic found a world—a world 90 times bigger than the Earth and not far short of 3,000 million miles from the Sun. It is still

dreams. It has not yet completed its first circle round the Sun since it was found in 1846. The Earth goes round the Sun in 365 days; Neptune goes round in 165 years. It was first seen at Leverrier's given point in 1846; it will not reach that point again until 2010. Where will this world be then, and you, and I?

Wonderful Machinery of the Moving World

One thing this chapter of astronomy teaches us: discovery of Neptune was possible because all this moving wonder moves to order. It is in complete control. No machine that man has made moves so perfectly, so silently, as this company of worlds. A man in 1682 saw a comet pass. He knew it would come back in 1759. The man was dead then, but the comet came back. We do not know where the United States will be in the year 2004, but we know where Venus will be in that year, and the day on which she will cross the Sun. We know that the Sun and the Earth are flying to a point in Hercules; we know they fly about 1,036,800 miles a day. It is said that the Sun and the Earth might collide; but our astronomers, the silent watchers of the universe, tell us that the Earth and Sun have traveled thousands of miles an hour for millions of years without an accident, and we are not afraid. These worlds are not blown hither and thither as feathers in the wind. They go the way marked out for them; they are subject to the laws by which a violet grows; they obey the Mind that dominates your life and mine.

ATALAN'TA. The fleetest-footed maiden of all the lands of Greece, and one of the loveliest, according to Greek myths, was an Arcadian king's daughter named Atalanta. When this fair princess was born, her father—disappointed to see a daughter instead

WHY ATALANTA LOST THE RACE



Atalanta, princess of Boeotia, had offered herself in marriage to any man who could outrun her, but this no man could do. Aphrodite, however, gave Hippomenes three golden apples and told him to throw them before her during the race. Atalanta stopped to pick them up, and lost the contest. The picture is Edward J. Poynter's famous 'Atalanta's Race'.

like a boiling mass; it has not yet shaped itself or cooled into a solid. We know that it has elements that make it up which are unlike any elements on Earth, but we know very little of this stupendous world that rolls and rolls and rolls so far beyond our

of the longed-for son—left her on a high mountain to the mercy of wild beasts and the elements. She was nursed by a she-bear, and was saved by some hunters who carried her to their home, where they trained her to be a skilled huntress.

When at last Atalanta was restored to her father's court, the king, having no other heir, entreated her to marry. Many youths came seeking to win her hand. But Atalanta, anxious to keep her freedom, declared that she would wed only the youth who should outrun her in a foot race, and further that all who entered the race and were unsuccessful must forfeit their lives. Many of the youths discreetly withdrew; while others, more rash, were outrun and perished.

At last there came a youth who had obtained the protection of the goddess Aphrodite (Venus), and carried concealed beneath his garment her gift of three golden apples. When the race began, Atalanta as usual easily passed her rival; but as she sped onward, an apple of gold rolled past her feet. For a moment she hesitated, then turned aside to pick up the precious fruit. Her adversary thus gained the lead, but soon Atalanta again overtook and passed him. A second apple then tempted her from her course, and a second time she lost and then recovered her lead, and sped on faster than before. She had all but won the race when the youth tossed the third golden treasure in her path. In the moment that she paused to pick it up, he passed her and reached the goal.

True to her promise, Atalanta married the youth who had outrun her. Unhappily the bridegroom forgot to give due thanks to Aphrodite, and that jealous goddess severely punished both him and his wife by turning them into lions to drag the chariot of Cybele, the mystical mother of the gods.

ATHENA. Of all the gods of Greece, next to Father Zeus himself, his daughter Athena was the wisest. She was especially the "goddess of wisdom," and old myths told the strange story of her birth—how she had sprung full-grown, and armed with shield and spear, from the head of Zeus and startled heaven and earth with her battle-cry.

Athena was the patroness of all the heroes who fought against evil men and monsters. Thus she was the constant companion of Hercules in his toilsome

adventures; she helped the Argonauts in their quest of the Golden Fleece; she was the guide of Odysseus (Ulysses) in his many wanderings. On her shield was the head of the snaky-haired Gorgon, Medusa, that the hero Perseus had slain through her aid, and which had the power of turning to stone those who gazed upon it.

In the long war about the walls of mighty Troy, Athena was ever the friend and counselor of the Greek chieftains. The poet Homer tells how once, when Ares (Mars), the hated god of war, and soft hearted Aphrodite (Venus) were aiding the Trojans, the goddess Hera (Juno) cried out to her husband Zeus:

"Hast thou no indignation with false Ares for these violent deeds? Wilt thou be wroth with me if I smite him and chase him from the battle in sorry plight?"

And Zeus the cloud-gatherer answered her:

"Go to now, set upon him Athena, who most is wont to bring sore pain upon him."

Then bright-eyed Athena cast down at her father's threshold her woven vesture, many-colored, that she herself had wrought, and arrayed her in her armor for doleful battle. Grasping her spear, great and stout, she took her place upon the flaming chariot while Hera smote the horses with stinging lash.

In the plain about Troy they found blood-stained Ares; and Athena, leaping upon the chariot of the hero Diomedes, cried:

"At Ares guide now thy horses, and smite him hand to hand, and I will help thee."

Then Diomedes with loud war-cry drove straight at Ares. Athena turned aside the war-god's thrust but Diomedes' spear of bronze she guided home against Ares' body, wounding him sore. When he felt the pain, brazen Ares belled loud as when ten thous-

and warriors cry out in battle, and like a cloud he fled from earth to Mount Olympus.

But Athena loved peace more than war, for she was



Reproduction of the famous bronze statue of Athena which stood on the Acropolis, where the gleam of its spear point could be seen as Athenian sailors rounded Cape Sunium.



Figures from the Panathenaic Procession on the Frieze of the Parthenon.

the goddess of spinning and weaving, agriculture, and all the useful arts. The invention of the plow and the loom was ascribed to her. She was the protector of towns and her city of Athens was especially sacred to her. How this city came to bear her name is explained by one of the old legends. Zeus had decreed that the city should be awarded to that one of the gods who should create the most useful gift for its inhabitants. Poseidon (Neptune) created the horse, but Athena, with superior wisdom, created the olive-tree, the sign of peace and source of prosperity, and the prize was given to her.

Athena was very proud of her skill as a weaver, and this once led her to an act of great injustice. A girl named Arachne had rashly boasted that she could weave as well as the goddess Athena herself. Athena heard this boast, and came to Arachne in the form of an old woman. She advised the girl to take back her words, but Arachne refused. Then the bent old woman changed suddenly into the wrathful goddess Athena, and cried:

"Prove now, O silly girl, your daring boast!"

The two stood at looms side by side and wove cloth covered with most wonderful pictures. When the goddess discovered that she could find no fault with Arachne's work, she became terribly angry. She struck Arachne and tore the cloth on her loom.

Arachne was so frightened that she tried to kill herself. Athena then became sorry for the girl and saved her life by changing her into a spider. So Arachne lives to this day, and still weaves the most wonderful of webs upon the grasses and bushes by the roadside.

Athena was a virgin goddess,—strong, pure, just, and wise. She is often called "Pallas Athena" or simply "Pallas." To her as the maiden (*parthenos*) goddess was dedicated the Parthenon, the beautiful temple on the Acropolis of Athens, the most perfect building the world has ever seen (*see* Acropolis). Every year at the festival of the *Panathenaea*, a robe, or *peplus*, woven by Greek maidens, was carried in procession through the streets of the city and presented to the image of the goddess. The huge gold and ivory statue of Athena in this temple, wrought by Phidias, greatest of Greek sculptors, represented her as a grave majestic woman, armed with helmet and shield. In one hand she held a statue of Victory (*Nike*), and at her feet was coiled a serpent, symbol of wisdom.

The Roman goddess Minerva, who occupied a similar place in the Roman mythology, came to be identified with the Greek Athena.

ATHENS, GREECE. It is a thrilling moment when one sails into the harbor of Piraeus, the port of Athens, and first sees in the distance—

Radiant, violet-crowned, by minstrels sung,
Bulwark of Hellas, Athens illustrious.

Rising afar and almost encircling the Attic plain, Parnes on the north, Mt. Pentelicus on the northeast, and Mt. Hymettus on the east, wrapped in purple

mist, still give to the "queen of cities" her violet crown, and after 2,500 years her glory is not faded.

Landing at Piraeus, we board a train for Athens, five miles away. The railway follows almost the same course as the famous "long walls" built by Themistocles in the 5th century B.C. to connect Athens with Piraeus and thus assure the sea-trading Athenians of access to sea even though besieged by an enemy's forces.

The Marble-white City and the Bright Blue Sky

Modern Athens, lying to the northeast of the ancient city, is "a city of whiteness and brightness." The buildings are nearly all of marble or limestone, or of stucco made of powdered marble; and seen against the brilliant almost transparent blue of the clear sky the effect is dazzling. The streets are lined with graceful pepper trees, bright green in summer, blazing with red berries in the autumn, and everywhere are squares and gardens filled with fragrant orange trees, date-palms, and rose-hued oleanders. Rising above the modern city and still dominating it as in ancient days is the hill of the Acropolis, "its noble temples seeming to fairly hang in the air like a vision disclosed of Paradise."

No one, it is said, can live in the presence of noble and beautiful things without being influenced by them. Perhaps this accounts for the spirit of culture that still pervades Athenian life. Even the laboring classes, though poorer than in most countries, are intelligent and never fail in courtesy. "We teach our children to treat people well," said a Greek to an American traveler.

A People who Live Outdoors

The Athenians of today, like those of 20 centuries ago, love out-of-door life. The restaurants which do not have adjoining gardens set their tables on the sidewalks. The most popular theaters are those roofed only by the sky. A stadium in which games and sports are held as in the ancient days was erected in 1895 for the first of the new international Olympic Games, occupying the site of the old stadium of Athens. Crowds gather in the streets to celebrate the great festivals—New Year's Eve, the Carnival before Lent, and Easter; and at all times the priests of the Greek Orthodox church are familiar figures in their long black robes and tall hats.

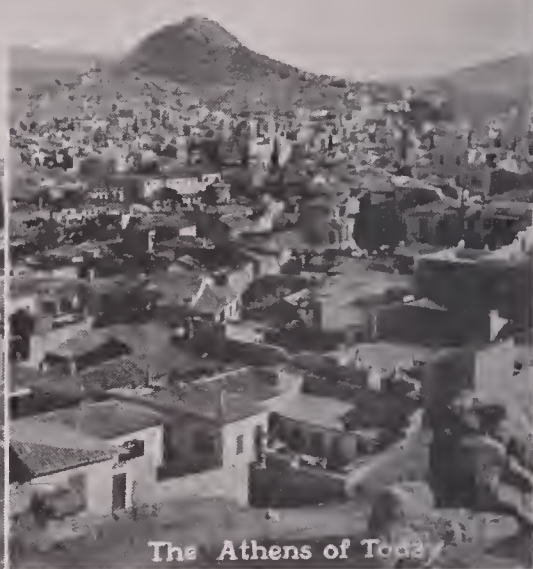
The royal palace in Constitution Square is a rather plain building of limestone and marble, set in a luxuriant garden filled with every kind of flower and overshadowed by great pines and giant cypresses.

From this modern city we easily step back into the world of the past. The Arch of Hadrian and the great ruined temple of Olympian Zeus are the chief remains from the period of Roman rule. Of the 104 elaborately carved Corinthian columns of the latter, each 56 feet in height and more than five feet in diameter, only 15 remain erect today. At their base little tables are set where fashionable men and women gather to gossip and enjoy their coffee and *loukoumi*, or "Turkish delight."

RUINS THAT RECALL THE GLORIOUS PAST OF ATHENS



The Acropolis from the S.E.

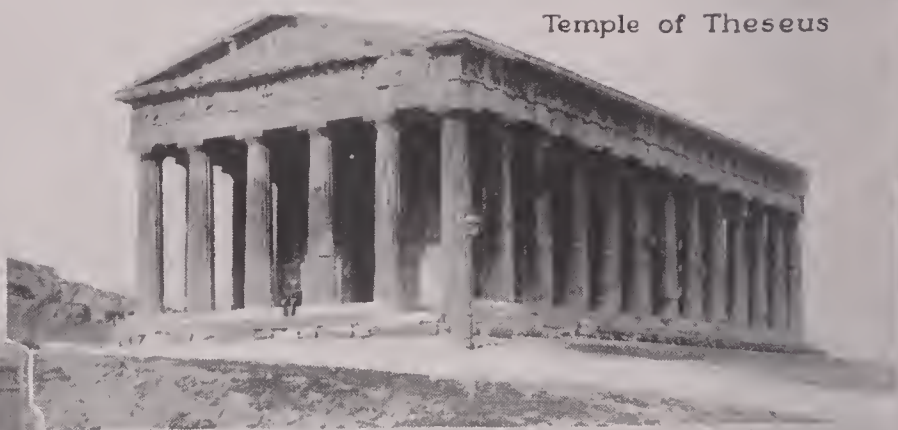


The Athens of Today

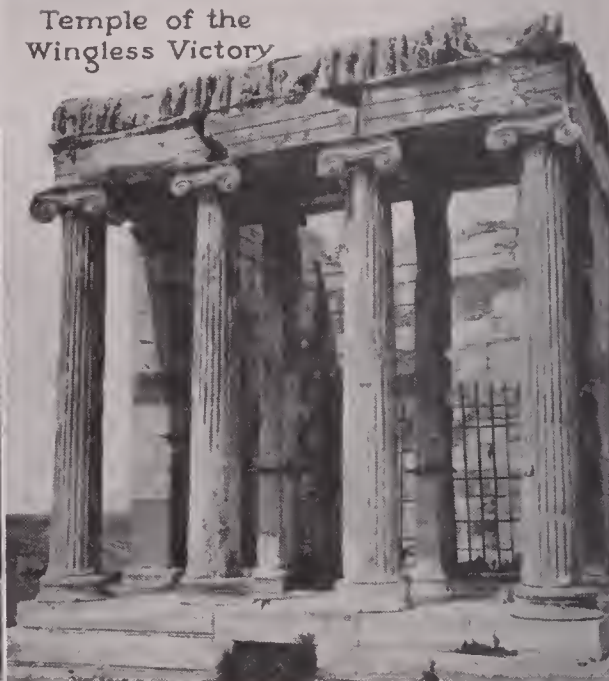
Monument
of
Lysicrates



Temple of Theseus



Temple of the
Wingless Victory



The Erechtheum showing Porch of the Caryatids



The Parthenon, which crowns the Acropolis, is so wonderful and so important in the history of architecture that it is illustrated and receives separate treatment in the article on Architecture. The Monument of Lysicrates is the only one left of a series of choragic monuments which once flanked the Street of the Tripods. The Theseum or Temple of Theseus, though not so beautiful as the Parthenon, is a noble example of the Doric style, almost perfectly preserved. The Erechtheum differs widely from the ordinary plan of Greek temples, having porticoes on three sides. The Caryatids are female figures which take the place of columns. The Temple of the Wingless Victory, on the Acropolis, is a beautiful example of the Ionic style. This exquisite little structure was built in the latter half of the 5th century B.C. It was demolished when the Parthenon was blown up by a cannon shot of the Turks in 1684, but fortunately the stones were not greatly damaged and in 1835 it was rebuilt.

For any subject not found in its alphabetical place see information

From the great period of Athens' independence we have the Theseum, or Temple of Theseus—the best preserved of all Greek temples. It has suffered somewhat from earthquakes and its marble facing was long ago burned to make lime, but its 34 severely beautiful Doric columns still support the roof and indicate its majestic proportions.

Passing by the ruins of the Theater of Dionysus, where the ancient Athenians listened to the masterpieces of Aeschylus, Sophocles, and Euripides, we ascend to the Acropolis. On this rocky plateau, which rises 200 feet above the level of the city, we come into the midst of the magnificent structures which have been the inspiration of all the world. The Parthenon as it exists today, shattered, defaced, almost entirely roofless, robbed of its statues and wonderful friezes, is still awe-inspiring in its beauty. Time has faded the brilliant painting and gilding with which the ancients decorated the pure white marble of their noblest temples, but it has given to the marble a wonderful color of amber-gold. Someone has remarked that the stone seems not to have been taken from the earth, but to have been quarried from the golden light of the Athenian sunsets (*see* Acropolis).

From the Acropolis we look out upon several lesser hills. To the west is the Pnyx, where the popular assemblies were held; and north of that we see the Areopagus—the Hill of Ares (Mars)—which was the seat of the venerable court of the Areopagus. Here later the Apostle Paul addressed his famous words to the Athenians, beginning: "Ye men of Athens, I perceive that in all things ye are too superstitious."

When we recall that in 1835 Athens, except for the ruined monuments of her ancient greatness, was a squalid Turkish village, the splendid growth of the modern city is all the more remarkable.

2500 Years of History

The beginnings of Athens are lost in myth and legend. It was said to have been founded by Theseus and named in honor of the goddess Athena. When the Persians at the beginning of the 5th century B.C. sought to conquer Greece, Athens played a leading part in resisting the invader. Under the great statesman Pericles, Athens reached its greatest power and splendor. Literature and philosophy flourished and those great works of architecture and sculpture were produced which made this the Golden Age of Greece.

But Athens had built up its greatness largely at the expense of its allies in the Delian Confederacy, and many of them, dissatisfied with this policy, turned to its rival Sparta. The war which followed, known as the Peloponnesian War, put an end to Athens' imperial greatness.

As a center of culture Athens was imperial for centuries more. Philip of Macedon conquered her, in spite of the oratory of Demosthenes, but this conquest itself became the means of spreading Athenian art and literature to the remote corners of Egypt and Asia through the world-empire of Philip's great son Alexander. In Roman times Athens was still the great

intellectual center. Cicero and many other great men of Rome went there to study.

In the Middle Ages the Goths and other barbarians harried Athens as they did Rome. From 1204 to 1458, as a result of the Fourth Crusade, the city was ruled by feudal lords from western Europe. Then the Turks conquered Athens as they had Constantinople. During a Venetian campaign against Turkey, in 1687, the Parthenon was used as a powder magazine by the Turks and suffered severely from an explosion caused by a Venetian bomb.

The Greek war of independence (1821–29) made Greece free once more and established Athens as the capital. In addition to a flourishing university, there are in Athens foreign schools of classical archeology for advanced students from France, Germany, Great Britain, and the United States. Athens is the financial and governing center of Greece, but its industries, chief of which are cotton, silk, and leather manufactures, are located in the flourishing port of Piraeus. Population of Athens and Piraeus, about 300,000. (*See* Greece.)

ATHLETICS. Before the middle of the last century there was practically no such thing as organized athletics in the United States, and even in England the first intercollegiate contest between Oxford and Cambridge did not take place till 1864. For a long period

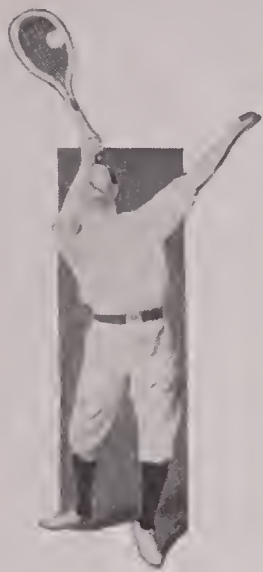


the keen desire of every normal boy to excel in athletic sports—to run faster, jump higher, or play games with more skill and vigor than his companions—was only half tolerated, and time spent in athletic pursuits was often regarded as time lost. But the energetic spirit of youth finally conquered the old-fashioned prejudices, and today men realize that athletics form just as essential a part of a man's education as books.

Athletics and the Greatness of the Greeks

We have really rediscovered a truth which was clearly recognized by the ancient Greeks. No race has surpassed the Greeks in intellectual ability, nor has any race surpassed them in perfection of physical development. The cultivation of athletics went hand in hand with the cultivation of science and art, and their great achievements must be credited to the emphasis they placed on training all the faculties, physical as well as mental.

There is no need, nowadays, to point out the advantage in every occupation or profession which the strong, vigorous, clean-cut man, the athletic man, possesses. But athletics, rightly considered, means much more than the development of mere muscle. The true ideals of athletics are not bone and sinew alone, but such qualities as quickness and skill; courage and manliness; pluck, energy, and endurance—in short, strength of mind and of character, as well as of body. The good athlete can take a whipping



without whimpering; he can likewise subordinate and adapt himself to the difficult demands of team play. He has what is called "sportsmanship."

The school or college athlete usually learns that "playing the game" means more than just winning. It means representing your class, your school, or your college in every way. It means being a good student as well as a good athlete. In fact the very best athletes, the boys and men who become captains, are those who have developed the brains of leadership through study.

A healthy spirit of rivalry gives zest to the game, but this can easily be carried too far. It may result in forgetting the true spirit of fair play, or may lead to overtraining and injury to health. A moderate amount of athletic recreation taken all the year around is far more beneficial than short and strenuous indulgence in a particular sport. In fact, schools and colleges are tending more and more toward organizing games and contests within their own walls, which will give every student a chance to take his part in the sports of each season.

Modern Athletics for Men and Women

In recent years girls and women have come to take an increasing interest in athletics. Almost all men's games are played by them, and statistics gathered in schools and girls' colleges show improved physical conditions as the result.

A clear distinction is made in the United States between amateur and professional athletics, and an athlete who



has once lost his amateur standing cannot take part in any of the contests under the jurisdiction of the national Amateur Athletic Union or of the Intercollegiate Association of Amateur Athletes of America. These and affiliated organizations control all amateur athletic events of any importance in the United States. An amateur may not compete for money or against professionals who receive money; he is likewise disqualified if he pawns or sells any prize obtained in an athletic contest.



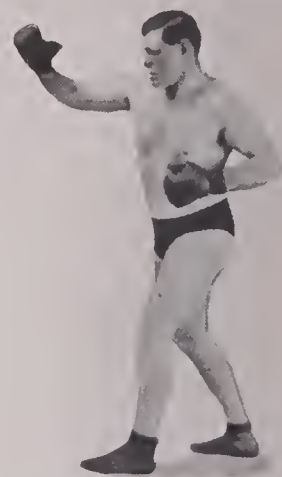
Broadly speaking, the term athletics includes all sports and pastimes which involve an element of physical effort. Usually, however, a distinction is made between athletics and gymnastics, the latter term being applied to purely muscular exercises in a gymnasium. The most popular athletic sports are baseball, football, basketball, hockey, tennis, and a variety of outdoor contests commonly grouped as track and field events, which include running, jumping, hurdle-racing, pole-vaulting, putting the shot, throwing the hammer and the discus. Swimming and rowing are important sports in many colleges and amateur associations. Handball and squash are favorites in athletic clubs, and amateur boxing, wrestling, and fencing are becoming more popular everywhere. The so-called "major sports," such as football, baseball, etc., are played in virtually all schools and colleges in the United States. These and the other important games and contests are described in separate articles.

The world's most important athletic contests are the Olympic Games. These were revived in 1896 to foster the

ideal of "a sound mind in a sound body," and to promote international friendship, as the former Olympic Games had done in the ancient Greek world (see Olympic Games). With the exception of the period of the World War, these events have been held at four-year intervals since 1896, always in some world-capital. Teams of picked athletes are sent

from the United States, Canada, Australia, New Zealand, South Africa, and most of the nations of Europe. More than 30 different branches of athletics are represented, including track and field events, rowing, swimming, trap shooting, rifle shooting, pistol and revolver shooting, figure skating, hockey, and tennis. Women take part in several of the events. In track and field events the representatives of the

United States have carried off the lion's share of the honors. (See also Physical Training, and the separate articles on each of the chief sports.)



LITTLE TALKS ON GREAT THINGS *by Arthur Mee*

THE HONOR OF THE PLAYING FIELD



ANY of the great lessons of life come from the games we play in youth. The great healthful games are those played out-of-doors. "Seek first the Kingdom of Out-of-Doors," the philosophy of games seems to say, "and you will find health and pleasure there." In the playing field and on the river we should seek, and we may find, a strong arm, a sure aim, a steady eye, and dignity of bearing. One of the first rules of games is to lay the foundation of a full and splendid manhood, and we should keep, as one of the mottoes of our outdoor life, the thought that a noble mind should live in a noble body.

We should play a game for its own sake, never spoiling the spirit of all true games, or lowering the dignity of all true manhood, by playing it for profit, at the expense of somebody else. If a game is not interesting enough in itself we should leave it alone. We should scorn to break the great rule of Fair Play by playing for a baser motive than the pure love of the game.

Play the game for the game, and for nothing but the game.

Our games are our own lessons in noble things. The playing field is in truth the High School of life. It is there we find the great distinctive qualities that mark the men of the English-speaking race all over the world. No American boy can be healthy and whole and miss the laws of honor. They ring through every school that is worth the stuff it is built of; they are blazoned as in letters of fire over every playing field worth walking on. They are among the oldest things in the world, and they will last as long as the human race. Even in olden days when men's sense of honor was curiously twisted, so that only a duel could satisfy it, a man would not take a mean advantage of the enemy he was about to kill, but would measure swords with him to see that the chances were equal and the fight was fair. And always at the bottom of all true ideas of sport, however men may forget it, is the great maxim, "A fair field and no favor."

We must think of the game and not of ourselves. That game is lost in which one member of the team seeks his own glory. The unity of all for a single cause, each playing his part for the general end, is the condition without

which no game is won. Chivalry, the surrender of self, obedience to the law that holds the team together—these things grow naturally with every game we play, and we should cherish them as a part of ourselves. We should be staunch and loyal and true; our comrades must be able to rely on us.

Especially we should be good losers; we should yield the palm with grace and cheerfulness to a victor who has played the game, leaving haggling, grudging, and quarreling to meaner souls, and not spoiling the temper of a game by claiming doubtful points or insisting on little rights. We must not strain the rules of a game so that the keeping of them breaks the spirit of them; we should be willing rather to lose a thousand games than win one by the shadow of unfairness. When the time comes, as it comes in all games, when nobody could see if your play were unfair, you will be glad to know that your loyalty is above suspicion, and will do the right thing as quickly as a lightning flash.

The sad side of human life, made up of cunning and intrigue, of seeking selfish ends at any cost to others, of preferring our vainglory rather than the achievement of a common good, of shutting our hearts to the troubles of others so long as we are prospering has no encouragement on the playing field, where only the flower of life, and not the weed, can grow. We must be loyal, or the game is lost. We could never be mean enough to withhold the applause that belongs rightly to the victor.

So that there grows up in us in our play that part of our life which makes the difference, as the years go by, between the men who help a nation on and the men who pull it back. The life of the world itself calls for those qualities in us which spring from the holding together of the team. If we hold together in the nation as we hold together in the team, in the boat race, in the tug-of-war, we shall give back to the nation a hundredfold the talents entrusted to us. If we are loyal to our team, to our school, we shall be loyal to our town and to our country; the very beginnings of patriotism lie in our games.

And now put down this book and go to your games. They will give you strength and courage; they will bring you selflessness and manliness. Play them well, and win.

ATLANTA, GA. Its rapid growth since the Civil War has made Atlanta, the capital and largest city of Georgia, one of the most important industrial and commercial centers of the South. It is in the north-central part of the state, about seven miles from the Chattahoochee River, near the foothills of the Blue Ridge Mountains. More than a dozen radiating railway lines make Atlanta the chief distributing center of the southeast, and it has a very extensive export trade in cotton, tobacco, grain, horses, and mules. Atlanta is also the financial center of the southeast, being the reserve city for Federal Reserve Bank District No. 6, which includes Alabama, Georgia, Florida, and parts of Tennessee, Mississippi, and Louisiana.

Large and varied manufacturing interests also center in Atlanta, the most important products being cotton goods, fertilizers, engines, car-wheels, machinery, lumber, sheet-metal work, terra cotta, bricks, wagons, furniture, cotton-seed oil, etc. Hydroelectric power for lighting, operating street-car lines, and manufacturing purposes is obtained from large water power developments in the mountains of north Georgia. Atlanta is the most important southern city for the publication of newspapers and periodicals, and also holds a high rank as an educational center. Some of its many schools and colleges are Georgia School of Technology, Emory and Oglethorpe universities for boys, and Agnes Scott and Cox colleges for girls.

Atlanta's altitude of 1,100 feet gives it an equable and invigorating climate, cooler than its latitude would indicate. The city has several beautiful parks, and near it are Camp Gordon and Jessup and old Fort McPherson, now used as an army hospital.

Atlanta was founded in 1837 as Marthasville. It became the terminus of the Savannah and Macon railway, and as one railroad after another extended its lines to the city, it was known as "Terminus"; later the name was changed to Atlanta. During the Civil War Atlanta was a depot of Confederate military supplies, and on this account was the object of a Federal attack which captured the city in 1864. All citizens were ordered to leave the city, and when Sherman started on his march "to the sea," a great part of it was burned by his order (Nov. 17, 1864). In describing Atlanta, Sherman held up his open hand and pointing to the wrist said, "Here is Atlanta and here at the fingers' ends are Charleston, Savannah, Jacksonville, Mobile, and New Orleans. Atlanta will always be the strategic city of the South."

Following the Civil War the city was rebuilt, and its growth since has been rapid. During the Reconstruction period the legislature was moved from Milledgeville to Atlanta, and the city became the permanent capital of the state by popular vote in 1887. Population, about 200,000.

ATLANTIC CITY, N. J. The fine bathing beach, many luxurious hotels, numerous shops, and places of amusement, together with the famous "board walk" which stretches along the beach for about five miles,

make Atlantic City exceedingly attractive to visitors. It is the largest and most popular all-the-year-round seaside resort in the United States, and is also a great convention city for organizations of all kinds. It lies 58 miles southeast of Philadelphia, has several seaside sanitariums and hospitals, and a busy resident population. Fishing and oyster-dredging are among the occupations. Population, about 52,000.

ATLANTIC OCEAN. To our distant ancestors the Atlantic Ocean seemed an illimitable expanse of water, as terrifying as it was vast, but today it furnishes us with a great highway of traffic, on the whole safer and cheaper than any railroad. Across it ply the great freight and passenger liners which form a veritable bridge of ships between the Old World and the New, while the wireless and the submarine cable afford a means of almost instant communication from one side to the other. Even airplanes have mastered this great barrier.

Of the three great oceans of the world, the Atlantic is first in commercial importance and second in size. It considerably exceeds the Indian Ocean in area, but it is only about half as large as the Pacific.

If by some means the water could be drawn off from the Atlantic basin, we should see a broad undulating plain, broken here and there by volcanic peaks, mountain ranges, and plateaus. On the whole the appearance of the floor of the Atlantic would be much smoother than the continent of America. On the average the ocean is between two and three miles deep, but near Porto Rico a sounding of 27,360 feet (more than five miles) has been made.

The Great Mountain Ranges under the Sea

A striking feature of the Atlantic floor is an S-shaped ridge running from north to south throughout very nearly its entire length. The ocean depth above this ridge averages from 9,000 to 10,000 feet, but on each side the floor of the Atlantic sinks into valleys 15,000 to 17,000 feet below the surface. The highest peaks of this submarine mountain range project above the water, forming the islands of the Azores group as well as St. Paul, Ascension, and Tristan da Cunha.

In the history of submarine cables, the Telegraph Plateau, lying between Newfoundland and Ireland, will always occupy an important place, for without this comparatively shallow bottom the laying of the first ocean cables would have been almost impossible. About 15 cables now cross the Atlantic. In the intermediate depths—that is from 500 to 1,500 feet—the Atlantic Ocean floor consists of a slimy ooze made up chiefly of the shells of millions of creatures which for ages have lived and died in those waters. At greater depths the bottom is composed of a kind of red clay showing the presence of meteoric iron.

Food fishes are abundant in all parts of the Atlantic, while near the surface live many varieties of sea mammals, of which the whale and the seal are conspicuous examples.

LINKS THAT BIND THE ATLANTIC WORLD TOGETHER



Every day is a busy day on the great Atlantic. Can you doubt it, looking at that web of throbbing cables and traffic lanes? How vividly the importance of these most traveled ocean waterways is brought home to us by the lines showing the routes of steamships and sailing vessels and the cables of the ocean beds! The arrows indicate the direction of the ocean currents. The spot marked "North American Depth" off the West Indies is the deepest known place in the Atlantic, more than five miles deep.

The Atlantic has several currents, both warm and cold, chiefly caused by the trade winds. Along the Equator from Africa to South America the waters move westward. In the neighborhood of Brazil they divide, one current proceeding into the Gulf of Mexico and thence northward forming the Gulf Stream, while the other turns to the south and circles back towards the African coast. The famous Gulf Stream, carrying the warm waters of the tropics, not only softens the rigors of the New England climate, but also exercises a moderating influence in countries as far distant as

the Scandinavian peninsula, which otherwise might be quite uninhabitable. The Labrador current, on the other hand, is a cold stream from the Arctic regions which carries into the Atlantic the icebergs which sometimes menace ocean travel.

There are no uniformly accepted limits for the Atlantic Ocean, but if we take the Arctic and Antarctic circles as the north and south boundaries, the length is about 9,000 miles. On this basis the total surface area would be about 34,000,000 square miles, or more than twice the area of North and South America.

contained in the Easy Reference Fact-Index at the end of this work

At its greatest width, between the Gulf of Mexico and the coast of Africa, the Atlantic stretches for about 4,500 miles. At its narrowest, between Cape St. Roque in Brazil and Cape Palmas in Africa, it has a width of approximately 1,600 miles. It is estimated that the yearly discharge of rivers into the Atlantic is 3,400 cubic miles of water, equal to about one-half of the river discharge of the world.

The Atlantic Ocean may have been named from Mt. Atlas, but more probably from the fabled island of "Atlantis" described by Plato. According to his description, Atlantis was originally larger than Asia Minor and Libya taken together and was situated outside the Pillars of Hercules (Gibraltar). The inhabitants had built up a great state, having conquered all the Mediterranean peoples except the Athenians, but their ambitions were suddenly brought to an end by a catastrophe in which their island was swallowed up by the sea. (See Ocean.)

The LATEST ANSWER to the OLD QUESTION, "WHAT IS MATTER?"

ATOMS AND ELECTRONS. The astronomer tells us that the heavens contain stars or suns which are so far away that it takes hundreds and

even thousands of years for the light to reach us from these stars, and all the time the light is traveling at the enormous velocity of 186,000 miles per second, or over five trillion miles per year! Also, some of these stars are so large that our own earth is a mere speck compared to them. From astronomy we learn of the infinitely big, of distances and of bodies so enormously great that the immensity of them overwhelms us.

On the other side, the student of physics and chemistry tells us of the infinitely small—that is, of molecules, atoms, and electrons. We learn that a body is made up of "molecules," and the chemist has shown that molecules are made up of still smaller bodies called "atoms," and that there are about 90 kinds of atoms or "elements." That is, all the various kinds of matter in the world consist of chemical combinations of these 90 kinds of atoms. Thus the water molecule consists of two hydrogen atoms combined with one oxygen atom.

An atom is inconceivably small. If 50 million hydrogen atoms were put in a row, the row would be only one inch long. To fill a cubic inch on this basis, it would take over 1,200 billion billion atoms. Can you think of anything as small as that?

And an Electron is Smaller Still!

For many years the atom was thought to be the limit of smallness; indeed the word "atom" is made up from Greek words which mean something that cannot be cut in two. But in 1897 Sir J. J. Thomson of Cambridge University, England, showed that there are bodies still smaller than atoms, which are obtained by breaking up the atom in the high vacuum tube called the Crookes tube. These parts of atoms are now called "electrons." Professor Thomson first studied electrons in the cathode rays of the Crookes tube; but electrons are found in various ways, as in the discharge from a hot metal wire, and from radium and similar substances.

The electron is infinitesimal in size compared with the atom; and while it is quite dense, it weighs only a

WHAT science tells us of the invisible units out of which everything is made, and the new theory that the least of these—Electrons—are merely tiny charges of Electricity.

small fraction compared to the lightest atom. Of course such infinitesimal bodies are not weighed by balances, and are not measured by scales, and

not even by microscopes; but they are weighed and measured with high exactness by methods described in advanced physics.

The striking fact about electrons is that each electron carries the same definite charge of electricity, and indeed the electron is simply an "atom" of negative electricity. These electrons revolve in the material atom about a positively charged center or nucleus, often called the "positive electron." Indeed, our best idea of the atom is that it consists of this positive center about which one or more electrons revolve like a moon around the earth. The kind of atom is fixed by the number of electrons that it has. Thus an atom with one electron is hydrogen, while an atom with six electrons is carbon.

Now we have the latest answer to the very old question, "What is matter?" or put in other words, "What are bodies really made of?" *Matter is finally made of electrons, that is of electricity, and it is electric forces that we have called "chemical affinity" and that hold bodies together* (see Electricity for illustration). This "electron theory" of matter is held in some form by all scientific men today; it is one of the marvelous results of recent science.

The Electrons and the Dreams of the Alchemists

But if all matter is made up of the same kind of substance, why cannot men change one kind of matter into another kind of matter? Why for instance cannot we change lead into gold? That is what certain men in the Middle Ages, the "alchemists," tried to do. Now, strangest of all strange things, it is found that one substance, radium, is changing of itself into another substance. The radium atom has the remarkable property that it loses electrons and in doing so gradually changes into another kind of matter. So far these changes—of one kind of matter into another kind of matter—are known to take place in only two or three cases, and these cannot be stopped or hurried by man. But scientists are wondering whether it is not possible to add or subtract electrons from atoms, and thus change at will one kind of

matter into another kind. If we could, then the dream of the alchemists and many even more remarkable things might be brought about.

The story of the infinitesimally small bodies, atoms and electrons with their marvelous activities, sounds almost like a fairy tale, but the wonderful thing is that we seem to be just at the beginning of these discoveries. Do you wonder that men who devote their lives to experiments in physics and chemistry are fascinated with their subject?

AUDION (*a'di-ŏn*). The electronic vacuum valve or "audion" is an important device used in wireless telegraphy and wireless telephony, and in long distance land telephony. It is an exhausted glass bulb that looks to the layman like an incandescent electric lamp. Inside the bulb there are, first, a tungsten wire filament that can be heated to incandescence by an electric battery; second, a "grid" of fine wires wound on a glass frame; and third, a metal plate. Besides the terminals for the heating battery, there are three exterior terminals, one to the plate, one to the grid, and one to the positive end of the tungsten filament. (For picture see *Wireless Telegraph and Telephone*.)

The action depends upon the fact that the hot filament gives off negative electricity very readily, but not positive electricity, so that a negative electric current flows quite easily across the vacuum space between the filament and the plate, but a positive current cannot flow. The electric connection with the grid also serves to regulate the amount of the current between the filament and the plate. Thus the vacuum tube acts like a one-way valve, allowing electric currents in one direction to pass but stopping currents in the opposite direction, and also regulating the amount of the current that passes.

By this instrument, wireless telegraph currents, which are alternating currents reversing themselves many thousands of times per second, can be changed or "rectified" to one-way pulses. Groups of these "rectified" pulses can be heard as "clicks" for dot-and-dash signals in an ordinary telephone receiver. The electron valve tube, in some form, is now the most used receiver of wireless signals. The three-electrode vacuum tube, or "audion" as it is sometimes called, can also be used as a perfect relay of oscillating electric currents—that is, it can be used to reproduce and magnify feeble currents without distortion and without time delay.

This quality of the audion has been found invaluable in long distance telephony. To telephone from New York to San Francisco, with ordinary instruments and with copper wires of reasonable sizes, would be impossible; but by using audions as relays the feeble currents produced by the voice in the telephone can be repeated and magnified at relay stations along the line. The invention of the audion has thus made possible long distance telephony.

The audion is also used to produce uniform and continuous oscillations of any frequency, which are

necessary for wireless telephony. Wireless telephony from airplanes, used so efficiently in the World War, employed audions both in the transmitter and in the receiver. The audion was first used by Prof. J. A. Fleming in 1904. The three-electrode tube or audion was invented by Lee DeForest, and has been improved by several inventors.

AUGUST. The month of August, the eighth in our calendar, was originally called "Sextilis" by the Romans because it was the sixth month (beginning with March). The Emperor Augustus renamed the month in his own honor because several of his victories and other fortunate events had occurred in it. He also increased its length from 30 days to 31, so as to make it equal to July, named in honor of Julius Caesar.

AUGUSTUS, EMPEROR OF ROME (31 B.C.—14 A.D.). The dagger blows which brought the career of Julius Caesar to an untimely end interrupted in mid-course



AUGUSTUS CAESAR
Emperor of Rome

that great dictator's plans for a far-reaching reformation of the corrupt Roman republic. The republic was already dead in fact, though not in name. So the assassins who struck down the dictator in the name of the republic plunged Rome into chaos, anarchy, and civil war, which lasted until another appeared who could carry on the work that

Caesar had begun. The new savior of Rome was the dead dictator's great-nephew Octavian. He was later called "Augustus" (venerable) by the grateful senate, in recognition of his services.

The Debt of Civilization to Augustus

To the Emperor Augustus the world owes the reorganization of the Roman state on a strong basis, enabling it to live on for several centuries and to accomplish its great work of transmitting to nations then unborn the civilization of classical times. To Augustus we owe the fact that our language and the languages of most of Europe are shot through with Latin words, just as our ideas, our habits, and our institutions are largely outgrowths of the old Roman culture.

When Caesar was murdered in 44 B.C., Octavian was a youth of 18, quietly pursuing his studies in Illyricum across the Adriatic Sea. A letter from his mother warned him to flee eastward to escape danger at the hands of his uncle's murderers. His reply was to proceed at once to Rome, where he assumed the name Julius Caesar Octavianus. His claim to succeed to his uncle's position was strengthened by the fact that he had been legally adopted by Caesar as his sole heir, and that a force of Caesar's veterans rallied to his support.

With this backing Octavian was able to force Mark

Antony and Lepidus, the two chief rivals for the mantle of Caesar, to come to terms with him. The powerful trio formed a triumvirate, or three-man alliance, which overthrew the republican forces at Philippi (42 B.C.), and divided the Roman world among themselves. Lepidus was soon stripped of his power, and Antony and Octavian were left to share supreme control—the former over the eastern provinces, the latter over Italy and the West.

But Antony neglected his provinces and spent his time in dalliance at the court of Cleopatra, the Egyptian queen, whose charms "age could not wither, nor custom stale." Octavian seized this opportunity to make himself sole master. He induced the senate to make war against Egypt, and advanced against Antony. The forces met at Actium on the west coast of Greece in 31 B.C. Antony was defeated and committed suicide, and Cleopatra followed his example (see Antony, Mark; Cleopatra).

At the Head of a World Empire

Octavian had now reached the goal of his ambitions. He was undisputed master of all the far-reaching domains of Rome. For the first time for 200 years, Rome was at peace; and Octavian was free to devise new methods for administering her vast possessions. All hope of restoring the reality of a republic was vain. The young ruler's task was to find a workable compromise between the old republican forms and the new condition of one-man rule. Henceforward he wielded his vast powers under the title of *princeps* (the "first citizen") and *imperator* (commander-in-chief), being invested by senate and people with certain additional powers attaching to the old magistracies. Though republican institutions were nominally preserved, the transition to the empire had actually been accomplished.

What He Did for Rome

The rest of the emperor's life was devoted to consolidating the provinces of Rome and reforming their administration, and to vain attempts to correct the evils which had undermined the sturdy virtues of the Romans and unfitted them for self-government. He built temples, encouraged religion, passed stringent marriage laws, and gave Rome for the first time organized police, fire, and water departments.

Augustus did so much to beautify Rome that it was said of him: "He found the city built of brick and left it built of marble." He established libraries and encouraged learning, especially the culture introduced from Greece. Some of the greatest names in Latin literature belong to his reign—the poets Vergil and Horace, the historian Livy, and others of less renown. So celebrated was this period that the term "Augustan Age" has come to be applied in the history of other nations to periods of great literary achievement. It was during this time that Jesus Christ was born.

After more than 40 years of peaceful rule (27 B.C.-14 A.D.), during which Rome enjoyed one of the greatest and most prosperous epochs in her history, Augustus died, leaving his stepson Tiberius to succeed him.

AUK (*ak*). Two centuries ago the great auk was found by the millions on the rocky shores and islands of northern Europe and North America. Today there is not a living specimen in existence, and there is no record of one's having been seen since the year 1844. Even mounted birds are very rare, there being but about 80 specimens of this once numerous family distributed among the museums of the world.

THE AUK WITH THE JAUNTY CREST



Go up into Alaska and in some places you will see the waters, the air, and the lofty cliffs fairly alive with these crested auks. The two birds in the foreground are male and female, but the two sexes are alike in plumage, which is comparatively rare in the feathered tribes.

This bird has disappeared because, although so alert and swift moving when in the water, it was stupid and clumsy on land. The great auk could neither fly nor run and was easily killed with a club. Its eggs and flesh were good for food and its feathered skin was of value to both savage and civilized man. So, when the auk came to shore for its nesting season, hunters and sailors ruthlessly killed it by the thousands; for the auk nested in colonies, the birds standing over their one egg, side by side, within touching distance of each other.

The great auk was a strange looking creature. It had a thick goose-like body about two feet long, with legs set so far apart that, when walking, it stood quite upright, like a man, but its legs were so short that the great webbed feet seemed attached directly to the body. It had a feathered coat of black with a vest of white, and its black wings, folded against the white vest, looked like small arms.

THE GREAT AUK



This is the Great Auk who, like the great Julius Caesar, lives only in memory. This drawing was made for this work by Dr. R. W. Shufeldt, the distinguished naturalist, from a mounted specimen.

The auk family (*Alcidae*) belongs to the order of diving birds (*Pygopodes*), which also includes the grebes and loons.

AURORA. Every morning Aurora, the goddess of the dawn (called Eos by the Greeks), drew back with

Besides the great auk (*Plautus impennis*) there are about 30 other species in the auk family, all of which are still found in northern waters. Among these are the crested auklet of the Pacific, which sometimes ventures as far south as Japan; and the razor-billed auk, which is sometimes found on the shores of Long Island. The same family includes the queer-looking puffins of the northern Pacific coasts and the murre, which are often seen in California and which nest in great colonies on the Three Rocks Reservation off the coast of Oregon.

her, Aurora begged the gods to allow him to live forever. Her prayer was granted. But alas! she forgot to ask that he might stay immortally young. So, as the years passed, Tithonus grew older and older. He shrivelled and shrank and grew feeble and shrill-voiced, until at last Aurora could no longer endure to look upon the husk of the man she had loved, and she changed him into a grasshopper.

AURORA BOREALIS. In the northern part of America and Europe, during both warm and cold weather, long quivering streamers of light are often seen in the sky. Usually they seem to radiate from an arc, and to send their rays far across the heavens. These bands of light are known as the aurora borealis or "northern lights." They are most often white, but sometimes they are red, green, or yellowish in color. These luminous bands may be almost straight, or they may wind back and forth in serpentine formation. Sometimes the rays resemble a fan, or form a crown of light about a dark center; or again long beams of light appear to fall downward like the folds of a curtain.

The aurora borealis is most frequently seen between 65 degrees and 80 degrees northern latitude. The area of visibility extends farther south in North

WHAT DAYBREAK MEANT TO THE GREEKS AND ROMANS



On the ceiling of the summer house of the Rospigliosi Palace in Rome, Guido Reni painted this fresco to express the conception of dawn in the classic mythology. It represents Aurora scattering flowers before Apollo's chariot, while the Hours advance in rapid motion.

rosy fingers the veil of night and heralded the coming of the sun. Wrapping round her the rich folds of her saffron-hued mantle, she sped across the heavens in her glorious chariot, or was borne aloft by her own fleet wings that glowed with ever-changing colors as she moved.

One morning, according to the Greek legend, as Aurora looked down upon the world of mortals awakening to welcome the glowing dawn, she beheld the fair youth Tithonus, and his beauty won her heart. She bore him away to her bright dwelling-place at the edge of the world, and there they were wedded. Dreading the time when death must take him from

American than in Europe. Scientists believe that the rays are due to discharges of electricity in the rare upper atmosphere, and that they travel along lines of magnetic force which point toward the magnetic North Pole. This theory seems more reasonable than the theory that the aurora is due to reflection of sunlight on ice crystals in the upper atmosphere. The colors are different from those in sunlight and have a closer relation to certain substances found in the upper air. The far-reaching magnetic disturbances which frequently accompany the brilliant auroral displays of the northern and southern hemispheres also bear out the electrical theory.

DOES THE SUN ALSO FURNISH THE NORTHERN LIGHTS?



It is still the "open season" for theories about the cause of the Northern Lights. One of the most interesting of these theories is strikingly expressed in this picture which shows how discharges of electricity are supposed to stream out from the Sun and then on reaching the upper layers of our atmosphere are turned aside to the North and South magnetic poles, where, according to this theory, they produce the Northern and Southern Lights in their various picturesque forms. These usually appear as long quivering streamers of white light radiating from an arc, though there are many different forms and colors. The rays often seem to move up and down so suddenly that they have been called the "Merry Dancers."

For any subject not found in its alphabetical place see information

AUSTIN, STEPHEN FULLER (1793-1836). Although the name of General Sam Houston is the one most frequently associated with the early history of Texas, it was Stephen F. Austin who was styled by the government of the state "the Father of Texas." Houston commanded the forces which won independence from Mexico, but Austin by leading American colonists into Texas had supplied the men who fought under Houston.

The attention of Austin's father, a Connecticut Yankee who had settled in Virginia, was early attracted to the possibilities of Texas as a field for American colonization, and he had secured from the Mexican government permission to bring colonists into that region. But he had died before the work could be completed, and his son—a graduate of Transylvania University (Kentucky) and a resident first of Missouri and then of Arkansas—took up the unfinished task. After surmounting innumerable difficulties Stephen Austin, in the summer of 1823, established a colony of several hundred American families at San Felipe on the Brazos River in South-eastern Texas.

Other Americans soon followed the example of Austin and his colonists, and Texas became filled with American settlers. Alarmed at this large immigration, the Mexican government passed laws to check it and to keep the control of affairs in its own hands. Texans felt these laws to be oppressive, and in 1833 they sent Austin to Mexico City to ask that Texas

might be made into a separate province with local self-government.

When Austin failed to secure an answer to his request he wrote home advising Texans to establish a constitution on their own account. Unfortunately the letter fell into the hands of the Mexican government. Austin was arrested and kept in prison for two years. When finally he was released and returned home in 1835, he advised the Texans to prepare for war, saying: "War is our only recourse. There is no other. We must defend our rights, ourselves, and our country by force of arms."

At first Austin was commander-in-chief of the Texan forces, but his health was in no condition for active campaigning. Furthermore he was the ablest statesman and the best educated man in Texas, and so could be of more use in the United States raising money and securing arms.

In the first election of the Texan republic, held in September 1836, the unassuming Austin was badly defeated for president by the brilliant general Sam Houston. To conciliate Austin's friends, Houston appointed him secretary of state; but Austin's health had been ruined by his work for Texas, and he died before its independence was firmly established. When, in 1837, the site of the present capital of Texas was incorporated, it was renamed "Austin City" in honor of this statesman, and two years later it was chosen as the seat of government of the state. (See Texas.)

The ISLAND-CONTINENT of AUSTRALIA

AUSTRALIA. Remote from all other lands, the vast island-continent of Australia is like a world unto itself. Even New Zealand, which we think of as its neighbor, is a four days' voyage away, while the distance to India is almost as great as from New York to Liverpool. Though it was the last of the continents to be discovered

and opened to civilization, it is the most ancient of them all—so ancient that its mountain peaks have been worn down by the waters and winds of countless ages to mere blunt stumps.

A Museum of Living Fossils

While most of Asia and Europe were still submerged beneath the ocean, Australia was dry land. Scientists tell us that it was once connected by a land bridge with Asia, and some believe with South America also. This bridge disappeared beneath the surface of the ocean in ages inconceivably remote, before the higher forms of animal and plant life had come into

Extent.—Greatest length east to west, 2,400 miles; north to south, 2,000 miles. Area (including Tasmania), 2,974,581 square miles. Population, about 5,500,000.

Distance from Other Points.—From New Zealand, 1,200 miles; Japan, 3,000 miles; India, 2,500 miles; South America, 6,300 miles; San Francisco, 6,750 miles; London, 11,000 miles via Suez, 12,750 via Panama Canal.

Natural Features.—Surface, flat and largely desert except in east and southeast. Mountains: Great Dividing Range, known at various points as the Australian Alps, the Blue Mountains, the Liverpool Mountains, etc.; highest peak, Mt. Kosciusko (7,328 feet). Rivers: Murray, Darling, Hunter, Clarence, Brisbane, Fitzroy, Burdekin, Swan, Murchison, Gascoyne, Victoria, Flinders.

Products and Industries.—Wool, frozen meats, hides, and tallow; wheat, hay, oats, barley, corn, potatoes, dairy products, sugar cane, grapes; gold, silver, tin, lead, coal, iron, etc.; timber. Textiles and clothing manufactures; smelting, metal working, flour milling, sugar refining.

States of the Commonwealth (with Capitals).—New South Wales (Sydney); Victoria (Melbourne); South Australia (Adelaide); Queensland (Brisbane); Tasmania (Hobart); Western Australia (Perth).

existence. Isolated thus through succeeding ages, this unique land has gone its solitary way, preserving for us, as if in a vast museum, forms of trees, flowers, and animals that have long since vanished from other parts of the earth.

The natives or "black-fellows" are very largely savages still in the Stone Age of civilization, no

farther advanced than were the peoples of Europe more than 5,000 years ago. Yet ancient and remote as Australia is, new life has entered it and made it in some respects the most modern country of the world. Today we hear much of Australia as the seat of the most advanced of governments, and the traveler's first impression as he lands at Sydney, or one of the other fine ports, is that of a busy, prosperous, progressive country.

This loneliest of the continents is also the most extraordinary in its physical characteristics. With all its vast area, almost equal to that of the United

States without Alaska, its coast is so little indented that it has less than 9,000 miles of coast line, being only three-fourths as long as Norway's. Along the northeast coast stretches for 1,200 miles the Great Barrier Reef, the greatest of all coral reefs, offering few safe openings for ships. There are, however, numerous spacious harbors along the southeastern coast. Many small islets dot the coast line, but the only nearby islands of importance are Tasmania, which forms one of the states of the commonwealth, and New Guinea or Papua, the British portion of which is now practically a dependency of Australia (see New Guinea).

Except for low wide ranges of mountains along the eastern and southeastern coasts, Australia is a great flat lowland, with only a few isolated groups of hills to diversify it. These Eastern Mountains, or the Dividing Range as they are usually called, intercept nearly all the moisture of the southeasterly trade winds, so that the rainfall on the eastern coast is abundant. Here are fertile agricultural areas, where grow most of the products of the temperate zone in the center and south, and tropical products in the north. Inland from the mountains the rainfall becomes scantier and scantier. Little but grass grows in this region, but it is a great grazing district where the sheep are pastured that make Australia the chief mutton and wool producing country in the world.

The Dreary Stretch of Rainless Desert

West of the grazing areas comes the huge expanse of desert that covers nearly all the rest of the continent. More than half of Australia receives less than 15 inches of rainfall a year, and more than a third receives less than 10 inches. This enormous uninhabitable ocean of sand and bare rocks reduces the usable area of the land by one-half, and isolates Western Australia from the rest of the continent even more effectually than if it were an island. The

west coast is mostly low and sandy, except for a few patches of grazing or farm lands and forest.

The tropical northern coast is alternately drowned under summer rains so heavy that plowing is almost

impossible, and parched by winter droughts. The overheated desert draws the monsoon rains from the north during November, December, and January, and tropical grasses spring up to a height of ten feet in those three months, but so coarse and rank that they are useless for stock-feeding.

Abundant moisture is brought by the "roaring forties,"—the westerly winds that belt the Southern Hemisphere between the

40th and 50th parallels of latitude—but most of Australia is too far north to benefit. The extreme southwest tip is fairly well watered, but the receding southern coast line along the Great Bight of Australia receives practically no rain for half its extent, until it bends to the south and catches the moisture of the western winds. The southeastern prolongation of the country is abundantly watered, as a rule, and contains some of the best agricultural and grazing land of the country.

Of the total area of Australia less than one per cent is under cultivation. Irrigation has redeemed many thousands of acres in the semi-arid regions, and several other great irrigating projects are on foot; but the extent of land that can thus be made available for tilling and grazing is a mere fraction of the vast tracts that must forever remain desert. Australia has no great system of rivers to store up moisture and water the soil. Its

streams are far fewer and smaller than those of any other continent, for it has no mountain snows to melt under the summer sun. Most of the Australian rivers are dry for part of the year, and few find their way to the sea. The one great river system is that formed by the Murray and Darling rivers,

NEARLY AS LARGE AS THE UNITED STATES



Imagine a sheet of glass of the size and shape of the United States laid down on a piece of sheepskin of the size and shape of Australia, and you will get a good idea of the relative size of the two commonwealths.

NATIVE AUSTRALIAN GENTLEMAN



He is in full dress—a bone in his nose, a bone ring on his forehead, his body seamed with parallel scars.

CHIEF SOURCES OF AUSTRALIA'S WEALTH



Here you see what a great contributor to the world's wealth Australia is. In the east and southeast, where there is sufficient rain, Australia already produces as much wheat as Kansas, and irrigation will greatly increase its yield. Its gold output is exceeded only by that of the United States and South Africa, and other mining interests remain to be developed, including coal and iron. In sheep raising, which is not so dependent as farming on rainfall, it leads the world, exporting enormous quantities of mutton and wool.

contained in the Easy Reference Fact-Index at the end of this work

WHEAT AWAITING SHIPMENT AT MELBOURNE



A characteristic sight at the great seaports of Australia is the enormous piles of wheat in bags, sometimes covering a surface equal to a city block or more. The Australians have not adopted the American system of grain elevators, which so greatly simplify shipment. The wheat is put into bags on the farms and remains in the bags until it reaches its ultimate destination. Rats sometimes work terrible havoc in such wheat stores as you see in this picture.

which drain the southeastern region. Irrigation therefore is obtained chiefly from artesian wells.

The eastern, southeastern, and northern coasts, with a few areas in the west, are the parts of the country where the people live, and a population map shows 80 per cent of the inhabitants in a belt about 100 miles wide along the eastern, southeastern, and southwestern coasts. Even in these settled portions the people are not overcrowded, for European immigration has been slow and the coming of Asiatics is discouraged in order that Australia may be "a white man's continent." The result is that Australia is less densely populated as a whole than Arizona, the most thinly populated of the states of the United States, having less than two inhabitants to the square mile. Though Australia constitutes a quarter of the area of the British Empire, it has only a little more than one per cent of the population of the empire. Though it is as large as three-quarters of Europe, it has fewer inhabitants than Holland.

Wealth in Her Cattle, Sheep, and Mines

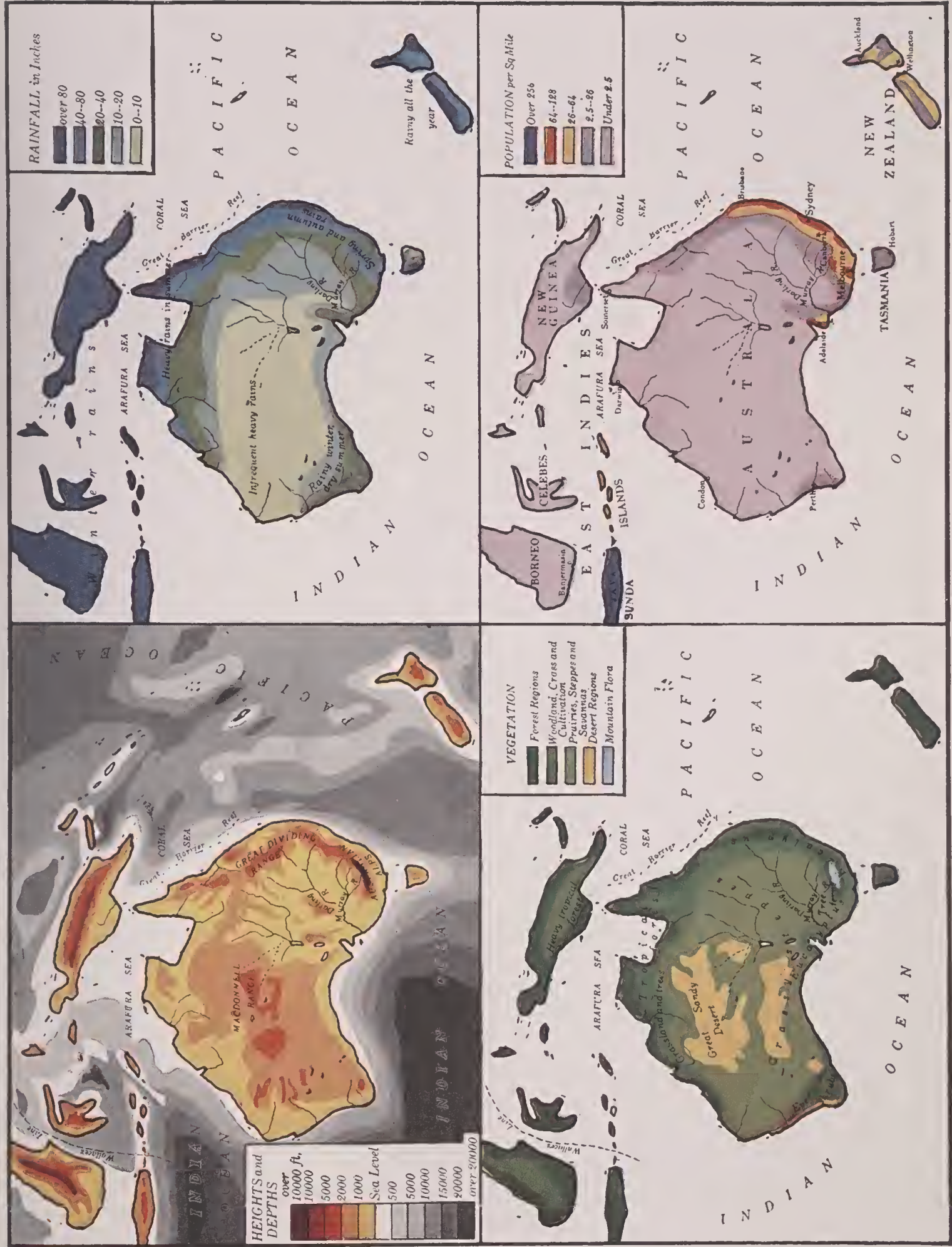
Australia's wealth lies chiefly in its cattle and sheep and its minerals. Large wheat crops are raised in the east and southeast, more than is needed to supply its scanty population, and so Australia is rated as one of the seven chief wheat-exporting countries, though its total crop is only about equal to that of Kansas. Grapevines thrive in many parts, yielding many tons of raisins and thousands of gallons of wine, both of which are exported in large quantities. Hay, corn, oats, barley, and other products of the temperate zone are grown in sufficient quantities for home demand, and the tropical regions of the central and northern coasts yield cotton, sugar cane, bananas, and rice.

But far more important than the agricultural products are the sheep and cattle. Sheep-raising is the main industry and wool is the great product, since sheep grazing is less dependent on rainfall than other pasturage. The flocks are kept on enormous ranches or "runs," sometimes 100,000 acres or more in extent and, because of the mildness of the winters, wool and mutton can be produced more cheaply than in most countries. Australian wool is chiefly merino of a quality unsurpassed for length, thickness, and fineness. Cattle are also raised in numbers great enough to make beef, hides, and dairy products important exports.

Almost as important to the wealth of the country are its mines. The discovery of gold in 1851 marks an epoch in the history of Australia, for it brought in thousands of immigrants. The output, which has been as great as \$90,000,000 in a single year, has declined recently, but is still large, being exceeded only by that of the United States and South Africa. There are also rich deposits of silver, copper, tin, lead, and zinc, which have not yet been fully developed. The abundant supplies of coal and iron point to great manufacturing possibilities, though as yet the manufactures of Australia are relatively unimportant. The pearl fisheries of the northern coast are among the largest known.

The more settled parts of Australia are well supplied with railroads, and in 1917 a transcontinental line was completed from Fort Augusta, at the head of Spencer Gulf in South Australia, to Perth in Western Australia, a distance of 1,052 miles. A line across the continent from north to south is also projected. Australia has more than 21,000 miles of government-

THINGS YOU SHOULD KNOW ABOUT AUSTRALIA



Notice how the densest population, the heaviest vegetation, and the greatest rainfall are found in the eastern strip of Australia between mountains and sea



WASHING GOLD OUT OF THE SAND



This picture illustrates the systematic way in which placer mining is carried on in Australia, by means of long wooden sluices with cleats or "riffles" at intervals. Quicksilver is placed in the riffles and this catches and holds the gold as the dirt is washed over, each successive riffle catching a portion of what preceding riffles have missed. The men with the shovels keep stirring the dirt and gravel to help this washing-out process.

owned railways, while only about 1,100 are privately owned; and the telegraph and telephone lines are also owned and operated by the government. The railroad situation is complicated by the fact that the "gauge" or width between the rails is not uniform in all the colonies, most of the railroads of New South Wales having the "standard" gauge of 4 ft. 8½ in., while those of South Australia are mostly "broad gauge" (5 ft. 3 in.), and those of Queensland are "narrow gauge" (3 ft. 6 in.). Numerous steamship lines connect Australia with the outside world, and there has been a marked increase in commerce with the United States since the opening of the Panama Canal. The admission of goods from Great Britain and Ireland at a lower rate of duty than from other countries ("preferential tariff") is designed to encourage commerce with the mother country.

The native plant and animal life of Australia is perhaps the most curious and interesting in all the world. Most of the more than 10,000 species of plants are found nowhere else in the world, and the animals are so different from those of other lands that scientists sometimes group all the animals of the world into two classes: Australian and non-Australian. In past geological ages, millions of years ago, the plant life that covered the earth was very different

from that of today. In America and Europe these primitive forms are found only as fossils, but in Australia they are still flourishing. In the moist tropical forests are huge tree-ferns, and gigantic lilies and tulips that are not garden flowers such as we know, but large trees. In all parts of the country we see the wonderful eucalyptus tree, native to Australia, of which about 300 species have been discovered—some of them measuring more than 400 feet in height. The wood of many varieties is remarkable for its strength and durability and is exported for building purposes. From the eucalyptus leaves and gums come many valuable oils (see *Eucalyptus*).

Various species of wattle, belonging to the acacia family, are of commercial importance for their timber and for their bark, which is used in tanning. The flower of the golden wattle, which resembles goldenrod in appearance, is the national flower of Australia, and in spring the valleys and gullies are ablaze with its radiance.

A Strange Zoo of Ancient Life

When the land bridge connecting Australia with the rest of the world broke down, the continent ceased to share in the progressive development of higher forms of life, with the result that its animal



That long sturdy tail of the gray opossum (or phalanger) of Australia is as useful to him as a fifth hand. By its aid he climbs trees with all the agility of a New World monkey. The grey opossum is about the size of a large cat and his fur is in great demand for the manufacture of carriage rugs.

life is distinctive. It has no native cats, pigs, horses, cattle, sheep, elephants, tigers, lions, camels, or other highly developed forms of animals. A few rodents and a wild dog called the "dingo" are almost the only kinds of the higher mammals. On the other hand, it has preserved scores of primitive animals which have been extinct in other lands for ages.

For example, there is the great kangaroo, famous for the prodigious leaps it makes and for the pouch in which the mother carries and nurses her babies. The wombat, the wallaby, and the bandicoot are the kangaroo's cousins; and it has many other relatives, some of them as small as mice, but all having the peculiar pouch which marks them as "marsupials," a family which, except for the opossum of North America and the opossum-rat of Patagonia, is no longer found on any other continent (see Kangaroo). Stranger still, perhaps, are the duckbill or platypus—a web-footed, beaver-tailed creature with a bird-like beak—and the spiny ant-eater, both of which are *egg-laying mammals*, the only creatures of the sort in the world. They form a connecting link between the mammals or "suckling" animals of today and the great family of reptiles from which the mammals and birds have both developed (see Duckbill).

The national bird is the emu, known as "the Australian ostrich" (see Emu). There are also many beautiful and sweet-voiced birds, among them the bower-bird, which builds a bower or playhouse, and the lyre-bird, famous for its plumage. Cockatoos and parrots enliven many a woodland scene by their chatter and their gorgeous colors. Also of interest is the famous "laughing jackass" or kookaburra, a member of the kingfisher family, whose curious cry and strange habits make it a perpetual source of wonder.

The natives of Australia—called "blackfellows"—are likewise remnants of a bygone age. They resemble the negro of Africa in color, and like the negro most of them have very broad flat noses, but their hair is wavy rather than woolly. When first discovered they were the most primitive of savages.

They wore no clothing in summer and in winter only the skins of beasts. For shelter they had only caves or huts of the rudest sort and often were mere nomads. They ate almost any kind of plant or animal life—not only the flesh of the kangaroo and opossum, but caterpillars, moths, beetles, lizards, snakes, etc. They did not cultivate the soil, and could not count beyond three or four. On the other hand, thousands of years of hunting life had made them amazingly cunning in tracking an animal to its lair and killing it. Their weapons consist of stone hatchets and spears, and most curious of all, the boomerang—a flat curved piece of wood which they used both in hunting and in war (see Boomerang). So severely have these primitive men suffered from the inroads of civilization and from the encroachments of the white settlers that only about 80,000 of them are left in the whole land.

The History of Australia

Australia was the last of the continents to be discovered by Europeans. The Portuguese knew something of the land as early as 1542 and Luis de Torres, a Spaniard, in 1606 sailed along the coast and gave his name to Torres Strait. Abel Tasman, a Dutch navigator, in 1642 discovered the island now called Tasmania, though he named it Van Diemen's Land. William Dampier, a free-booter, in 1688 was the first Englishman to set foot on Australia.

It was not till 1770, however, that the real nature of the land became known. Captain James Cook in that year, as head of an English scientific expedition, landed in Botany Bay, where Sydney now stands. He explored the eastern coast northward and planted



The spiny ant-eater, or echidna, which is found in Australia, Tasmania, and New Guinea, is remarkable for being the only mammal in the world (except its relative, the duckbill) that brings forth its young in eggs. Its slender snout and long sticky tongue enable it easily to pick up the juicy larvae of ants on which it chiefly feeds.



This big relative of the kangaroo, called the diprotodon, was nearly as large as a small elephant. Compare his size with that of the giant kangaroo near him, and the 4-foot log he has his paws on. The diprotodon has been extinct for many thousands of years but scientists have found its remains in great abundance in dried-up salt lakes of Australia.

the English flag on Cape York, thus establishing the British claim to the continent. Of the many explorers of the interior, the most remarkable for personal daring was Edward John Eyre. In 1840 he began a

colonies soon followed, but it was not till 1896 that practically the whole of the continent had been explored. The discovery of gold, in 1851, brought a rush of immigration that greatly increased population.

THE RESCUE OF EDWARD JOHN EYRE



Edward John Eyre was one of the greatest Australian explorers, for he explored from the shores of the Great Australian Bight to King George's Sound, in Western Australia. On the point of starvation, with just a single native "boy" left of his expedition, he lighted a fire on a rock and so attracted a passing ship. Weak and emaciated, he staggered with outstretched arms towards his rescuers. Never had they seen such a figure. Having been given up for lost, he seemed to them like a man from the dead.

perilous journey from the Great Australian Bight, which led him through 1,200 miles of wilderness and scorching desert. More than a year later, accompanied only by a single native "boy," he came out on King George's Sound, in Western Australia. He had traversed the whole route which in a general way is now followed by the Transcontinental Railway.

The first settlement came soon after the loss of most of England's colonies in America, when a body of such convicts as had formerly been sent to them was landed in Australia, forming the beginning of the colony of New South Wales (1788). Other British

made for a new capital at Canberra, where work was begun in 1913. This city, like Washington in the District of Columbia, is in a district set apart by the government and known as Federal Territory (see Canberra).

Australian cities are among the most up to date, the cleanest, the most attractive in the world, for none of them suffer from overcrowding, and slums are unknown. Sydney, the largest city and the seventh in size in the British Empire, is about as large as Boston or St. Louis. It owes its importance, and in large measure its beauty, to its spacious harbor, with "deep water fingers stretching miles up

A Land of Progressive Policies

In 1900, after local jealousies had balked many attempts to unite, the six Australian colonies formed a federation under an act of the British Parliament, which went into effect the following year. The name of the new federal government is the Commonwealth of Australia, and it is one of the youngest of the great states of the world. Its constitution was modelled on that of the United States, and—unlike Canada—all powers not specifically delegated to the federal government are retained by the states. Like Canada, Australia is practically self-governing and independent, though the governor-general of the commonwealth and the governors of the various states are appointed by the British Government. Primary education is free and compulsory. Equal suffrage is enjoyed by men and women. Strict laws have been passed to further the policy of a "white Australia" and exclude the colored races. Australia was one of the first countries to enact old age and invalid pension laws, and it is noted for its advanced legislation in connection with labor problems. The "Australian ballot," now used in England, Canada, and the United States, is one of the modern reforms which originated in this progressive country.

The temporary seat of the federal government was established at Melbourne, but provision was

between wooded banks'' (see Sydney). Melbourne, which has been called the "Chicago of Australia," has many unusually beautiful public buildings, parks, and gardens (see Melbourne).

Adelaide offers perhaps the most attractive recreational and outdoor life, and is famed as a residential city. Throughout all the Australian cities there is an air of prosperity and well-being. Wealth is more evenly distributed than in most other advanced nations. There are comparatively few very rich and no very poor people. It has been said that "labor is king" in Australia. Working

OLD ENGLAND IN THE NEW LAND



No wonder young Englishmen feel so much at home in Sydney. It doesn't look at all like a new town in a new land, but like a fine old town in Mother England. The University of Sydney as you see in the photograph, is a splendid structure in the Gothic style.

conditions are excellent, and hours so regulated as to give abundant leisure for the outdoor sports and picnics which are the favorite forms of recreation.

IN THE STREETS OF MELBOURNE



Half the population of the province of Victoria lives in Melbourne, the capital. The city is noted for its many handsome public buildings and parks. This view in the shopping district gives an idea of its substantial appearance.

The Literature of Australia

Australian literature is largely a growth of the last half-century, but already the commonwealth can boast of a considerable number of notable writers. Their works are full of the local color of convict life, gold hunters, and bushrangers, as well as "the burning wastes of barren soil and sand" and other Australian nature notes. Among the chief poets of the earlier period are Adam Lindsay Gordon, who won fame by his 'Sea Spray and Smoke Drift' (1867), and 'Bush Ballads' (1870); and Henry Clarence Kendall who ranks as the national poet because of his 'Leaves from an Australian Forest' (1869), and 'Songs from the Mountains' (1882). More recent writers of verse are Edward Dyson ('Rhymes from the Mines', 1896); Henry Lawson ('While the Billy Boils'), and A. B. Patterson, whose 'Man from Snowy River' (1895) is one of many poems filled with the life of the drover. Australian fiction is represented by Marcus Clarke's convict tale, 'For the Term of His Natural Life' (1870); by the many delightful novels of bush, diggings, and convict life written by Thomas Alexander Browne ('Rolf Boldrewood'); by Walter Jeffrey's South Sea tales, entitled 'By Reef and Palm' and 'Wild Life in the Southern Seas'; by Guy Boothby's 'The Beautiful White Devil' (1896); and by Arthur Hoey Davis ('Steel Rudd'), whose unflattering sketches of the Queensland small farmer put him in the humorist class. These are but the merest samples, for already Australia has to her credit more

than 300 volumes of published novels and tales, by writers born in Australia or who have come from the mother country to make the island continent the scene of their lives and work. Australians also take pride in the fact that Madame Melba, the world-famous operatic singer, was a native of their Land of the Southern Cross.

Other Facts of Interest About Australia

Australia is the only continent wholly surrounded by water and the only one wholly within the Southern Hemisphere.

Nearly half of Australia lies within the tropics, but the

FALLS WILL BE FALLS!



Waterfalls will be waterfalls, laughing and dancing toward the sea, wherever they are! This is Erskine Falls, near Lorne, Victoria, in one of Australia's rainy regions.

air in summer is so dry that a temperature of 120 degrees in the shade does not cause as great discomfort as a temperature of 90 does in New York City or London. Frost seldom occurs except in the great interior desert, which is also the hottest part in summer. In no part does enough ice form for skating.

White ants, or termites, are a terrible plague in some sections, eating away unprotected woodwork wherever they can get at it.

Australian wheat is planted and reaped with the most up-to-date machinery, but the grain is handled in a primitive way. There are no grain elevators, and the grain is packed in bags in the fields and remains in those bags until it reaches its destination. Great piles of bags 20 feet high and covering the space of a city block are familiar sights at shipping centers.

Camels originally imported from Asia are used for transportation through the Great Desert.

Australia has 100 species of snakes, three-

fourths of them venomous, and 390 kinds of lizards, some of them six feet long. None of the large animals found there attack man unless brought to bay.

Countless millions of rabbits, the descendants of a few introduced in the middle of the 19th century, would soon turn all the grazing lands into grassless desert, were it not for ceaseless vigilance. Millions of frozen rabbits and rabbit skins are shipped to England every year. More than 100,000 miles of wire fences have been put up to check their ravages.

Twenty-three distinct varieties of palm found nowhere else grow in Australia.

Ninety-six per cent of the inhabitants are of British origin. Most of the remainder are Chinese, with a sprinkling of other Asiatics and Pacific Islanders.

Less than four per cent of the white population is illiterate, as against nearly eight per cent for the United States. Every second person in the country has a bank account. Less than six per cent of the total area of Australia is in

private ownership; 46 per cent is held under various forms of leases and licenses from the crown, and about an equal area is entirely unoccupied.

Considerably more than half of Australian trade is with Great Britain and other members of the British Empire.

The scope of governmental action, both in the Federation and in the various states, is far greater than in the United States. Public ownership of utilities, including railroads and street cars, is the rule. The governments own most of the lands, which they sell or lease to farmers, further assisting buyers with loans from state banks at low interest. Governments make clothes and machinery, run warehouses and stores, and operate mining plants. Hours of labor are regulated by law; pensions are paid those disabled by old age or sickness; bonuses are given to mothers on the birth of each child; minimum wages are prescribed; arbitration of industrial disputes is compulsory.

Since 1911 Australia has had compulsory military training. At about the same time it began to create a navy, which included about 20 vessels in 1914.

During the World War of 1914-18 Australia rendered invaluable service to the Allies. Its navy helped to clear the Pacific islands of German ships. Volunteer troops to the number of 300,000 were sent to France, Gallipoli, Macedonia, Egypt, and Mesopotamia, and more than two-thirds of them were killed or wounded. By the peace treaty of 1919 all Germany's Pacific possessions south of the Equator were put under the administration of Australia or New Zealand.

AUSTRIA. The present state of Austria, as established by the treaty of St. Germain (Sept. 10, 1919), is a mere fragment of the great Austro-Hungarian Dual Monarchy which joined with Germany in 1914 to plunge the world into war. Its territory of 32,000 square miles includes only about one-eighth of the lands that constituted the former monarchy, and its population numbers only 6,500,000, compared with the 53,000,000 ruled from Vienna by the emperor-king, Francis Joseph. The present Austria consists broadly of the former Austrian provinces of Upper and Lower Austria, Salzburg, Styria, Carinthia, and the north part of Tyrol and Vorarlberg, with the addition of certain slices of western Hungary inhabited by Germans.

The new republic was proclaimed as a separate state on Nov. 12, 1918, the day following the armistice which concluded the World War. It has been greatly hampered by the burden of debt, reparation claims, poverty, and unemployment which resulted from the war. A large proportion of the people would favor union with Germany, but such a step is forbidden in the peace treaties, except with the consent of the council of the League of Nations.

The chief occupation of the country is agriculture, but production is not equal to its needs. Manufactures of automobiles, pianos, and textiles are the next most important industries. Iron ore, lignite (a low-grade coal), copper, zinc, and lead are among the mineral resources, and timber abounds.

The capital, Vienna, was once "the gayest city of Europe" and an important manufacturing center, but the influence of the war has crushed its gayety and splendor and paralyzed its industrial life (see Vienna). Other important cities are Gratz (population, about 156,000), Linz (70,000), Innsbruck (57,000), and Salzburg (37,000).

The "CRAZY-QUILT" that WAS AUSTRIA-HUNGARY

AUSTRIA-HUNGARY.

Four hundred years of wars and intrigue and fortunate marriages produced the motley "crazy-quilt" of a dozen or more nationalities, speaking over a dozen languages, which was formerly Austria-Hungary. Four and a half years of reckless war tore it to fragments and destroyed what had been one of the five Great Powers of Europe.

If we had viewed this region from an airplane before 1914 we should have seen a land stretching from the lofty Alps of Switzerland on the west to the granite wall of the Carpathians on the east, and from the plains of Germany and Russia on the north to the mountainous peninsula of the Balkans on the south. It is a country made up of many geographical blocks, and with a population divided into an even larger number of national groups.

A Land that Artists Love

In the west are the lofty Alps of the Tyrol, rivaling in their grandeur the mountain monarchs of Switzerland. Here is the land of rapid rivers and pleasant valleys interspersed amid snowy peaks and glaciers of the mountains. We catch glimpses of vine-clad hills, of fruitful valleys, and of prosperous farms dotted with flocks and herds and flecked with hundreds of white geese and ducks. Pines cover the upper slopes of the mountains, and beeches and chestnuts the lower ones, while perched on occasional cliffs we see the ruins of ancient castles which carry us back in imagination to medieval days. And everywhere by the roadsides are sheltered shrines with crucifixes, before which the devout Catholic peasants stop to tell their beads in prayer.

As we sweep northward in our plane there unfolds a panorama of lake and mountain, the highlands gradually becoming less rugged until we see the "beautiful blue Danube" flowing between the hills and meadows of the crown-lands of Upper and Lower Austria. Vienna, the former imperial capital, is set

Extent.—North to south, 800 miles; east to west, 650 miles; area, 261,241 square miles. Population, about 51,000,000.

Mountains.—Eastern Alps, Carpathians, Bohemian Forest, etc.; the most mountainous country in Europe after Switzerland.

Rivers.—Danube, with its tributaries, the Save, Drave, and Theiss; Moldau and Elbe in Bohemia.

Principal Products.—Iron and steel, coal, wheat, textiles, sugar, wine, etc.

States Formed from Austria-Hungary.—Czecho-Slovakia; Jugoslavia; Austria; Hungary. Poland and Rumania also received parts of Austria-Hungary.

like a jewel in the midst of rolling grain fields, but is somewhat obscured by the smoke of the many factory chimneys, for this was the workshop of the Hapsburg domains. In it were produced most of the machines and steel rails, the clothing and the leather goods, which were shipped down the Danube, the commercial highway of the empire; while the farmers of

Hungary sent back meat, grain, and wine in return.

Crossing the Moravian Hills we reach Bohemia, a diamond-shaped quadrilateral surrounded on three sides by mountains—the Bohemian Forest, Ore Mountains, and Giant Mountains—and on the fourth by the steep hills we have just passed. In this province—jutting far into Germany—high blue mountains, dark forest-upland, and broad hop and barley fields alternate, with here and there picturesque prosperous cities and villages. The capital Prague lies in the center. Innumerable streams give fertility to the soil and are used also as a motive power for factories that make Bohemia famous. Coal, iron, and other minerals are abundant, and contribute to Bohemia's manufactures of Bohemian

glass, of iron and steel, of textiles, toys, beet sugar, and beer. By sailing close to the ground we may see the goose-girls, with their gay petticoats and bright kerchiefs, watching their feathered flocks, and the shepherds tending their herds in their stiff sheepskin coats which serve as protection from the rain and snow in winter and from the sun in summer.

From Bohemia we cross the narrow agricultural and industrial province of Austrian Silesia—all that was left by the greed of Frederick the Great of Prussia to the young queen Maria Theresa out of a much larger province of that name. So we come to Galicia, the fateful booty torn by Austria from unhappy Poland when that kingdom was extinguished in the 18th century by its powerful neighbors. No obstacles obstruct our view here, for this country, stretching away to

A FROWNING CASTLE OF THE TYROL



Castle Runkelstein, perched on a lofty pedestal of porphyry, is one of the many frowning strongholds in the Tyrol to remind us of the turbulent Middle Ages. It was built in the 13th century, near the little town of Bozen in that part of the former Austrian Tyrol which has been given to Italy. An extraordinary collection of frescoes telling the stories of Tristan and Isolde and other medieval legends adorns its walls.

THE GREAT EMPIRE THAT WAR DESTROYED



"If we had viewed Austria-Hungary from an airplane before the war, we should have seen a land stretching from the lofty Alps of Switzerland on the west, to the granite walls of the Carpathians on the east, and from the plains of Germany and Russia on the north, to the mountainous peninsula of the Balkans on the south."

the Carpathians on the south, is a seemingly interminable plain, bleak in winter, and agriculture is almost the sole occupation of the people. Here nevertheless are the historic old city of Cracow and the thriving industrial Lemberg, the third city in size in Austria-Hungary. The Polish peasants—the men in their queer long white coats, and the women with their large shawls and brilliant head-dresses—form picturesque groups in the country market-places and in the well-cultivated fields. The style of dress varies with nearly every village, but in all we can easily discern the brilliant scarlet and the white of the national colors of the Poles, who form about one-half of the population of Galicia, the other half being Ruthenians.

Hungary, the Land of the Magyars

Turning south from Galicia we reach Hungary, the "land of the Magyars," lying in the far-flung bow of the Carpathians, more than 800 miles across. This was an Austria-Hungary in miniature, in which the proud Magyars of the plains lorded it over their Rumanian fellow-subjects of the mountainous forest-land of Transylvania and over the Croats and other

South Slavs. Here high mountains alternate with fertile valleys, while the great granite wall of mountains is made beautiful almost to its summit with trees of many kinds, and the lower slopes are covered with vineyards from whose fruit is made the famous Tokay wine. The fertile plains of Hungary are the granary of Europe. Covered with fields of wheat and corn they furnished food not only for the people of Austria-Hungary, but likewise for other countries. Passing by the great amphitheater-shaped city of Budapest, we see here and there the clustered roofs of villages between plowed fields and pasture-grounds filled with herds of horned cattle. Before the white-washed cottages here and there sit peasants in blue jackets and trousers, the wife with a dark blue apron over a white linen gown.

Crossing the deep swift flood of the Danube we reach the Slavic lands of the south—Croatia and Slavonia, Bosnia and Herzegovina. At first we cross broad fertile plains, rich with vines and luxuriant foliage, with here and there beech and oak forests in which numerous herds of hogs find abundant pro-

PEASANT SCENES IN AUSTRIA-HUNGARY



Home of a Peasant



A Village Street



The Burden Bearers



For the Pea Soup



The Village Bell

The thatch-roofed house of the peasant shown in the upper left-hand corner of this group is made of stone, plastered and white-washed. The next picture shows an attractive home in a village. Everywhere in Central and Eastern Europe women do much of the heavy labor. The last picture shows a quaint old bell tower in the center of a village. Above women are drying peas to be used in the thick soup, which forms an important part of their diet.

vision. Great open spaces are covered with rose plantations, while wild mignonette, scarlet poppies, lilies, orchids, and wild thyme give forth a perfume which reaches us even in our airplane. We sail by to the lofty desolate highland region beyond, where mighty snow-capped peaks rise tier upon tier, their lower slopes descending into great lonely dark forests of oak and fir. And as the scenery changes from plain to mountain, so the white linen garments of the plainsmen give place to the brilliant peasant dress of the mountain folk. All are engaged in agriculture, but their methods are primitive and their crops are poor.

But these lands are far more fertile than those of the magnificent but barren half-Slavic and half-

Italian district of Dalmatia, on the coast of the Adriatic. There great mountains, with their snow-capped peaks lost in the clouds, wash their feet in the peaceful sea. And yet Goths and Slavs, Magyars and Turks, Venetians, French, and Austrians for centuries fought for this stern and rock-bound coast. For here are located the only good harbors of the eastern coast of the Adriatic—Triest the modern rival of Venice, and Fiume the storm center of the Paris Peace Conference, which were Austria-Hungary's only outlets to the sea. Here also we see the town of Cattaro, with its dark-gray bleak and wind-swept rocks towering above its peaceful fiord. We pass by proud Ragusa, bride of the sea and daughter

of the mountain, which for hundreds of years (until 1815) maintained itself as an independent republic. And if we are flying low enough we may see the sleepy little town of Spalato, which today is literally built in the palace of the emperor Diocletian, the courts and corridors serving as streets and open spaces for the town. In the fairs and market-places of these towns, which serve as places of amusement as well as of buying and selling, we catch glimpses of the coin-decked head-gear and the bejeweled dresses of the neighboring peasants.

Dalmatia is our last stop on our air-voyage, for when we turn towards the north we come once more to the snow-capped Alps from which we started. From our airplane we could not learn the most peculiar thing about this former state, for we were too high up to hear the many different languages spoken by its peoples.

Suppose you were to take a trip from Portland, Me., through Vermont, Massachusetts, Connecticut, Rhode Island, New Jersey, and Maryland, down to Virginia, and in crossing these eight states you should find people speaking 21 different languages. Or suppose that you should go from New York City to Cleveland, Ohio, and in that distance have to know 20 different languages to be able to understand what the people were talking about. This is the condition you would have found in Austria-Hungary, if you had gone by train or automobile through this land which we have viewed from our airplane; and yet the territory is no greater than the United States from Maine to Virginia, and from New York to Ohio.

Do you wonder that Emperor Francis Joseph, who ruled this land from 1848 to 1916, had trouble in governing his people, when he had to publish in 11 different languages his call for a meeting of parliament? At one time Austria herself recognized this weakness and tried to make German the official language of the whole land and so far as possible to Germanize the people; but the attempt was foredoomed to failure. In 1848 the Bohemians (Czechs) and the Magyars almost won their independence,

but the Magyars tried to Magyarize their Croat fellow-subjects, just as Austria had tried to Germanize them all, and as a result the South Slavs aided Austria in crushing the Magyar republic. Bohemia was then bombarded into obedience. In 1869 the

Magyars were taken into partnership with the Austrians in what was called the Dual Monarchy of Austria-Hungary. This partially satisfied them, but left the Poles and the Ruthenians, Czechs and Jugo-Slavs, no better off than before.

When Austria-Hungary was defeated in the World War of 1914-18, the end came and the old dominion of the Hapsburgs ceased to exist. Even the original nucleus, Austria, passed from the hands of this royal house, which had ruled the land since 1278, when Rudolph of Hapsburg obtained it. Hungary, curtailed of Transylvania, became an independent republic. Out of the remaining territory were resurrected the national states of Poland and Czechoslovakia (based on the old Bohemia), while the Slav lands south of the Danube cast in their lot

with Serbia to form the new state of Jugo-Slavia.

The real growth of the Hapsburg family began with Frederick III (1440-93), whose reign illustrates the saying that "while other states grew by wars, Austria grew by fortunate marriages." Under him Tyrol was acquired and a basis was laid for the future addition of Bohemia and Hungary. He inscribed on his buildings and possessions the five vowels "A E I O U," which were interpreted to mean *Austriæ est imperare orbi universo* (in German, *Alles Erdreich ist Oesterreich unterthan*), that is, "The whole world is subject to Austria." Under Emperor Charles V this boast came near to fulfillment, but his vast possessions were soon divided between a Spanish and an Austrian branch of the Hapsburgs.

When Queen Maria Theresa came to the Austrian throne in 1740, Frederick the Great of Prussia unscrupulously seized part of her territories. In the War of the Austrian Succession which followed, Prussia gained most of Silesia, but Austria maintained the rest of her possessions. In the latter part of the same century Austria shared in the shameful partitions of Poland. In 1908 Bosnia and Herzegovina were added, in disregard of promises made in 1878.

The government of Austria-Hungary since 1869 was a Dual Monarchy consisting of the Austrian Empire and the Hungarian Kingdom. Each managed its own affairs, but had the same ruler and the same ministries for common affairs.

YOUNG PEASANTS IN HOLIDAY DRESS



One of the most interesting things to the traveler in Central Europe is the amazing variety of picturesque national costumes. This is the holiday dress of young Rumanian peasants of Transylvania, which was formerly a part of Hungary. The man's linen tunic and wool trousers are of homespun material.

The AUTOMOBILE and HOW IT WORKS

AUTOMOBILE. We must know something about many things if we would know how to run an automobile. It has come to seem a simple thing—something that any intelligent boy can do after a few lessons. Yet when the driver takes his seat and touches levers and controls with his hands and feet, he is really the unconscious master of all the powers stored up in electricity, explosive gasoline, and water under hydraulic pressure of pumps. When he sets a spark flashing in imprisoned gas, pistons begin to work, water to flow, and air fans to whirl; batteries are stored with more electricity; then, as his foot releases the clutch, gears whirl and wheels turn on their cushions of air and rubber, and he dashes away in a marvel of steel and mechanics that is as wonderful as the magic carpet in the tales of the 'Arabian Nights'.

There is no limit to the new things men can make from old things, and, after all, it is the old things that men have combined in an automobile. And nothing is older or more wonderful than the use they have made of a drop of gasoline stored centuries ago in the bowels of the earth. Like an imprisoned jinn, it hauls great trucks of coal to our doors, or whirls us away to new lands and new pleasures.

No invention ever made by man met with the immediate and widespread success that distinguishes the automobile. In 1896 there were four automobiles in the United States. They were heavy, cumbersome, and easily outdistanced by a horse and carriage. Twenty-five years later 2,000,000 motor vehicles were being manufactured *each year* in the United States alone—most of them swift and powerful machines—

A MAN on foot can travel at best 30 miles from his home between sunrise and sunset; and a 30-mile circle in the United States contains on the average 90,000 persons. A man on horseback has at his command a 60-mile circle, containing perhaps 500,000 persons. But a man in an automobile, with a day's range of 300 miles, widens his horizon to include 9,000,000 individuals. This suggests the importance of the automobile to civilization. Whether a man be a doctor, a scientific expert, a political leader, or a salesman, his value depends to a large extent on the scope of his personal influence or service. So you see the automobile has, in this sense, made one man equal to 18 on horseback, and equal to 100 men on foot.

and in the list were types adapted to any sort of work or travel. It was estimated that there were 10,000,000 automobiles in the United States, or one for every ten inhabitants.

In those 25 years the whole system of traffic was revolutionized. To-day all over the world the automobile has

largely replaced the horse. The former khedive of Egypt drove his cars in sight of the pyramids, and the sultan of Turkey rode in an imperial limousine. The high passes of the Alps and the Vale of Cashmere, the frozen steppes of Russia, the burning sands of Arabia, and the wide veldt of South Africa have all been conquered; and motor sledges have even penetrated the icy desolation of the Antarctic continent with the ill-fated expedition of Capt. Robert F. Scott. In the United States, where there are more automobiles in proportion to the population than in any other country, hundred-mile trips are made as casually as a journey to the next town was formerly undertaken. In the cities the roar of the thousands

of trucks and automobiles is like Niagara; and in the country not merely does the automobile link the farmer to town as never before, but automobile tractors make it possible for one man to accomplish more plowing, reaping, and other work than 20 men could formerly do.

In the great World War the automobile was so important that some enthusiasts have declared that "the automobile won the war." The motorcycle and the armored

motor car took the place of the cavalry scout of the older days. Shells for the great field and siege guns went up to the front in motor trucks, and many of the guns themselves traveled with the shifting

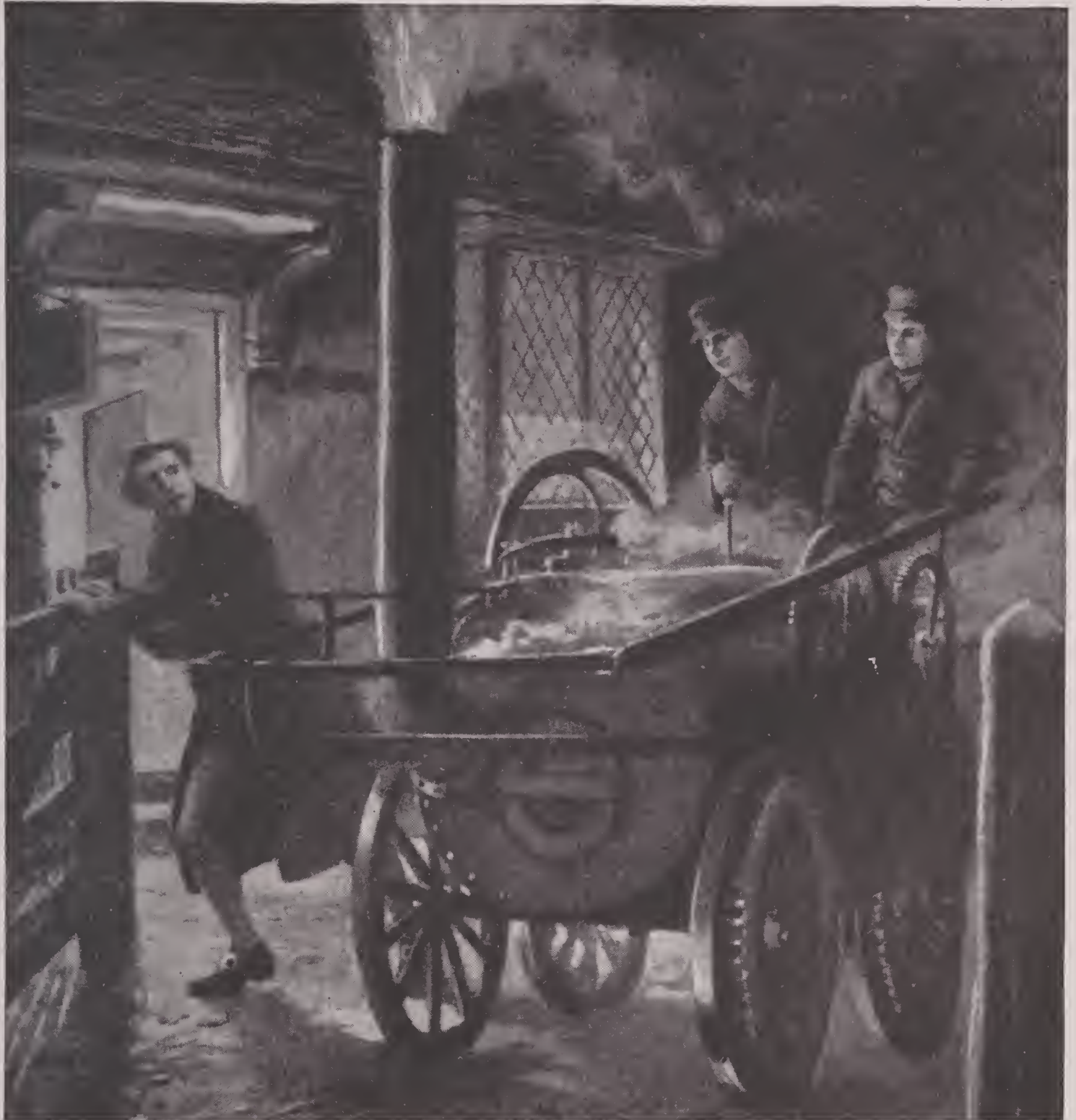
THE GRANDFATHER OF AMERICAN AUTOMOBILES



This is the earliest successful American automobile propelled by gasoline. It was built by Elwood Haynes of Kokomo, Ind., in 1893-94 and is now preserved in the Smithsonian Institution at Washington. It is really nothing more than a modified buggy with an engine installed. But a horse could beat it easily in a race.



THE TWO "EVIL SPIRITS" WHO PAID NO TOLL



Doesn't look much like the high-powered automobile that carries us through cities and whisks us over country roads at sixty miles an hour, does it? And yet, if it hadn't been for this queer contrivance, possibly we wouldn't have had any modern automobiles. This road locomotive, for which the frightened toll-keeper is opening the gate, was invented and built by Richard Trevethick in 1800 and was the first self-propelled vehicle that ever ran along a road. Trevethick and a companion are here shown passing a toll gate. The toll-keeper, thinking they are two evil spirits, assures them with chattering teeth there is nothing to pay, but he will appreciate it if they will pass on as quickly as ever they can!

tide of battle by means of specially constructed motor tractors. The "field kitchen" that brought hot food to the front line trenches trundled along at the tail of a motor truck. Tens of thousands of motor trucks made up the transport trains that brought ammunition and supplies from the railroad bases to the fighting lines. And when the fighter was struck down, it was the motor ambulance that carried him back to the base hospital.

But the automobile could fight as well as scout,

attack as well as provide and minister; for the mighty "tanks" that charged irresistibly over barbed wire entanglements, trenches, and concrete fortifications were automobiles—mighty children of the American farm tractor of the "caterpillar" type. And if the automobile has rather brusquely shouldered the horse out of many of his old occupations, it has repaid him in some measure; for who can estimate the number of horses that were saved from suffering and slaughter by the use of the automobile in war?

contained in the Easy Reference Fact-Index at the end of this work

An automobile is simply a car that moves of itself on an ordinary road, carrying passengers or freight. The freight automobiles are known in America as "motor trucks," in England as "lorries," and in France as "camions." The great majority of automobiles are run by gasoline engines, although there are many electric cars and a few driven by steam.

The speed of the automobile has been developed far beyond the limit of practical value. Nearly all of the larger cars are able to travel from 50 to 60 miles an hour, which is enough for the most extreme emergency. Yet racing machines have more than doubled this speed.

Although the automobile has developed only within a few years from a rattling untrustworthy "horseless carriage" into the swift sleek silent machine

Haynes, and a Benz, the last an imported German car. It was two years later before any cars were purchased. The beginning of automobile manufacture in this country is claimed by Alexander Winton, of Cleveland, who in 1898 built and sold four cars.

The electric automobile came earlier than the gas car. In 1891 the first electric automobile was built, and made its appearance on the streets of Chicago in 1892. "Ever since its arrival," said the *Western Electrician* of Sept. 17, 1892, "it has attracted the greatest attention. The sight of a well-loaded carriage moving along the streets at a spanking pace with no horses in front, and apparently with nothing on board to give it motion, was one that has been too much even for the wide-awake Chicagoan. In

PHOTOGRAPH GALLERIES ON WHEELS



Motor trucks were in use for all sorts of purposes in the World War. Here is a group of war photograph galleries on wheels, each truck with its trailer serving as dark room, laboratory, and living quarters for the men. Within a half hour from the time the aviator had taken views over the enemy lines, prints had been made and were in use by artillery officers in directing their fire.

of today, the idea of a self-propelled vehicle is not new. More than 200 years ago Sir Isaac Newton thought of such a conveyance, and in 1769 Nicholas Joseph Cugnot, a Frenchman, made the first automobile ever built—a three-wheeled steam carriage which actually ran a few miles on the roads of France, and then upset because it was too heavy to take a sharp turn at three miles an hour!

Some Early Automobiles

It is difficult to decide who invented the first gasoline-propelled automobile. Perhaps the chief credit belongs to Gottlieb Daimler, a German, who by 1884 had developed the Daimler engine which was applied to automobiles. France contributed most to the automobile's early development. In the United States it is claimed that Charles E. Duryea of Pennsylvania constructed a gasoline automobile in 1892. The earliest successful American automobile of this type, now in the Smithsonian Institution at Washington, was constructed by Elwood Haynes, of Kokomo, Ind., in 1893-94. In 1896 there were but four gasoline cars in the United States—a Duryea, a Ford, a

passing through the business section, way had to be cleared by the police for the passage of the carriage."

The difficulties encountered in the early days in inducing capitalists to invest money in automobile manufacturing is well illustrated in the story of a young inventor who, during his apprenticeship in an electric light plant, worked and studied and finally evolved a car which he believed could sell for a popular price. After many discouraging failures he finally succeeded in interesting a stove manufacturer, who agreed to lend him \$27,000 provided he would not tell anyone. "I can't afford to let anyone know I am lending you this money," said the stove manufacturer, who knew what ridicule would follow if it became known that he had risked his money in so foolish a scheme. His investment in the young inventor's idea, however, returned a dividend as high as 1,300 per cent in a year. Today the name of that struggling inventor is known wherever cars are sold; it is that of Henry Ford.

The first automobile had many faults, but an improvement was founded on every mistake and it

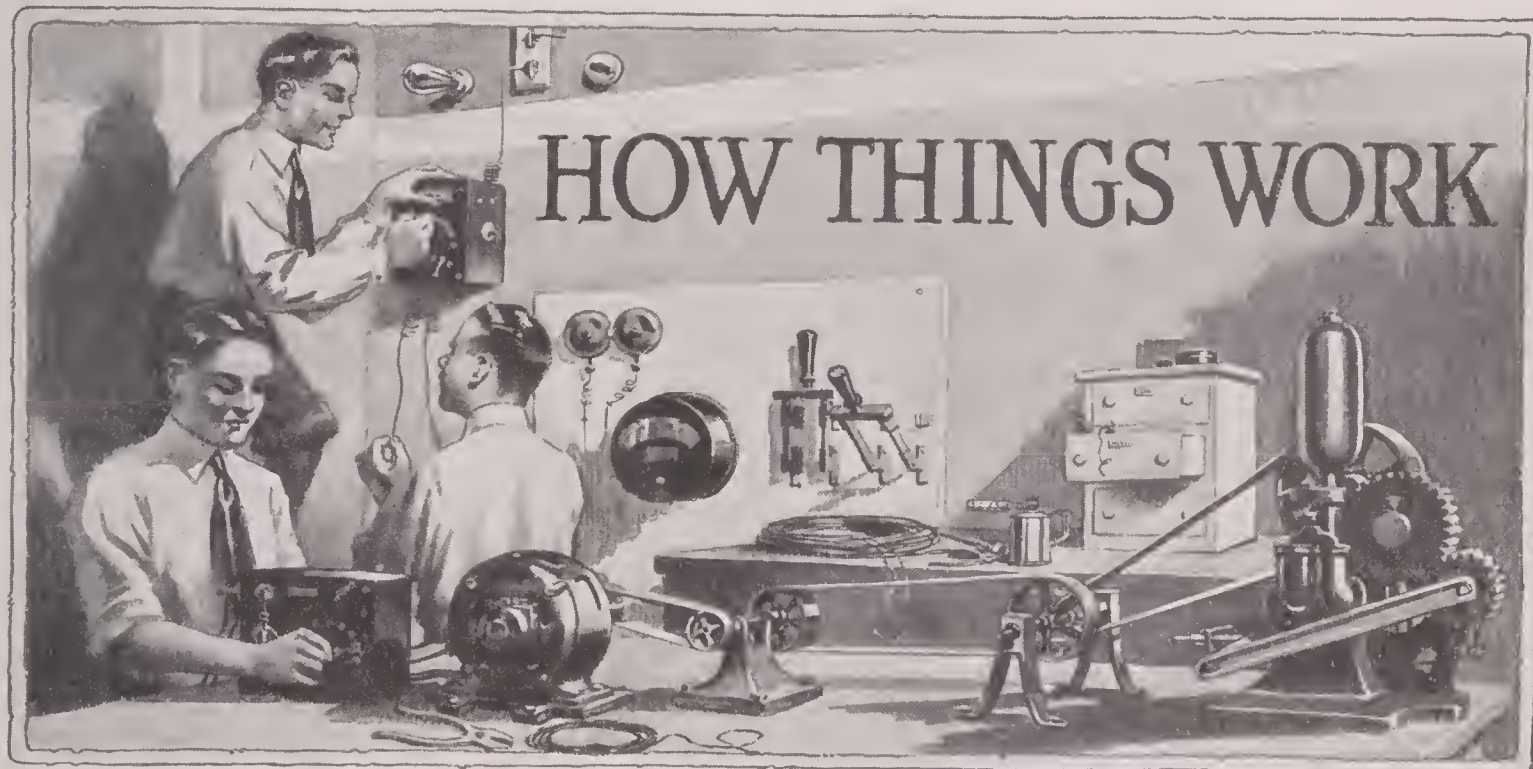
was not long before the motor car began to find itself. Today the automobile industry in the United States ranks sixth in the list of the nation's industries.

The great step forward in the manufacture of automobiles has been the standardization of parts. If the hundreds of manufacturers who sprang up had produced cars with different sizes of standard parts, requiring owners of cars with which something has gone wrong to wait indefinitely for a particular device used by a certain company, the nation would never have been so completely "automobilized" as it is today. This standardization does not extend to the bodies of the cars, but engines are so standardized as to insure quantity production at cheapened cost.

A Glimpse of the Factory

An automobile factory is a big place, for thousands of parts made of many different materials must be manufactured with much complicated machinery. The various pieces must be very accurate, some to the thousandth of an inch. Every detail of construction has a separate department—the machine shops, wood-working department, paint rooms, upholstering rooms, etc. The complicated engines, as delicately built as a watch, are put together and rigidly tested in another department. Every big factory has a well-equipped laboratory, where scientific research is carried on and new possibilities in carbureters, engines, rubber, and gasoline are revealed.

The automobiles are put together by "progressive assembling," and no one who has seen this wonderful demonstration of efficiency can ever forget it. First the two long side bars are fastened together by the cross pieces, and this bare frame is placed on a moving platform which is drawn steadily forward along a chain or belt. Its route leads past a long stockroom, and as it passes, workmen attach the various parts, sometimes jumping on board and working until their particular piece is in place—the springs, brackets to support the running boards, a muffler, the axles, and many other things. A spray of naphtha cleans the car of any dirt or grease it may have accumulated, and a coat of paint is then sprayed on. The frame disappears into the drying room, and when it reappears on the other side it gets a coat of varnish and disappears again into a hot room to dry. When it has cooled it resumes its journey. At a definite point the engine is swung up from below, or comes along another track and is fastened securely in place in the frame, which is now called a *chassis*. The ignition system is installed, the wheels are slipped in place, the body swings down from above, and the tires, lamps, and clock suddenly appear, ready to be attached. Every few yards an inspector tests the work done. Finally it comes to the end of the track, a completed automobile. Fill its tank with gasoline and it is ready to start across the continent.



How an Automobile Works

THE modern automobile is a marvel of compact arrangement. Everything that clever engineers can do to make it dependable and easy to run has been done. While its mechanism may seem at first extraordinarily complicated, once you have learned the purpose of each of the parts, you will realize how essentially simple is the general plan.

Let us now, with the help of the pictures, master the details of this wonderful machine and see what happens when the driver begins to work his levers.

1. THE AUTOMOBILE'S "BRAIN CENTER"

The man who drives an automobile must think of nothing else. He has enough to do. His hands and feet are instantly ready and alert, and his attention

should never be off the appliances on which the safety of the car depends. He has before him, as he sits in his seat, the steering wheel, the lever for changing speeds, the brakes, the delicate mechanism for increasing the flow of gasoline, and the pedal controlling the clutch. It is enough for any man to do with the lives of many people in his hands.

There are two brakes—one worked by hand and one by the foot. The foot brake usually works directly on the outside of the brake drums, which are fastened to the rear wheels. This is the brake for ordinary use and by its friction it simply slows down the driving wheels. The hand brake or “emergency brake” usually acts on the inside of the same brake drums, and is adjusted so that when it is pulled back hard it will lock the wheels and prevent them from turning at all. This is used when it is necessary to stop very suddenly or when the automobile is to be left standing. In some automobiles one or the other of these brakes may work upon the driving shaft instead of upon the wheels.

The gear-shift lever for changing speeds is moved backward or forward or to the sides, each motion bringing a different set of cogwheels into position between the shaft driven by the engine and the shaft connected to the back wheels. As shown here, the gear-shift is in “neutral,” the engine shaft and the driving shaft are not linked together, so that, although the engine might be running, the car would not move. The clutch pedal is a simple but very important instrument. It provides a means for disconnecting the engine from the driving mechanism while the gears are being shifted into place, which makes it possible to start the automobile without a jerk and saves the machinery from sudden strains. Next to the foot brake is the accelerator, serving the same purpose as the gasoline control lever on the steering wheel. By using this foot control, it is possible to increase or decrease the flow of gasoline to the engine without removing either hand from the steering wheel. Next to the accelerator is the button controlling the self-starter, which consists of an electric motor run by a storage battery. This motor twirls the engine shaft when the driver wants to start his car, and does away

with the old-fashioned method of getting out in front of the automobile and cranking it by hand.

The instruments on the dashboard are as follows: the “choker,” with which pure gasoline can be fed to the engine, making it easier to start; the switch,

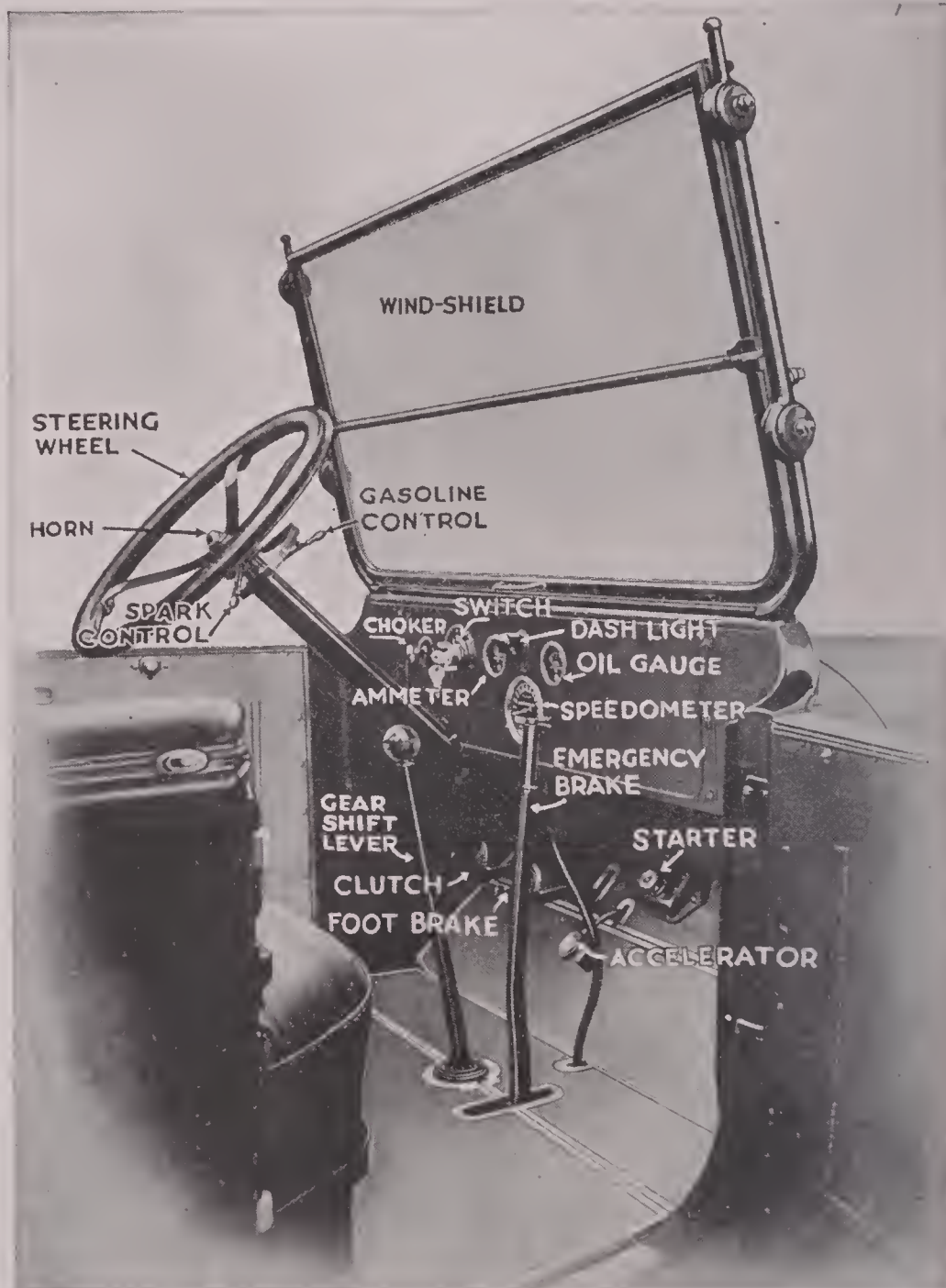


Fig. 1. The “Brain Center” of the Automobile

which controls the electric current for the sparks that explode the gasoline in the cylinders, and which also turns the lights of the automobile on and off; the ammeter, which tells the driver the amount of electric current the storage battery is receiving or discharging; the speedometer, which is connected through the flexible cable beneath it to the driving mechanism, and which tells how fast the car is moving; the oil gauge, which indicates whether the lubricating oil is circulating properly; and, finally, the dashlight, which illuminates these instruments for night driving.

On the steering wheel, besides the gasoline lever there is the spark-control lever which regulates the

time of the explosions in the engine, and the button which sounds the electric horn. The column which supports the steering wheel is composed of an outside jacket containing three movable tubes fitting inside one another, the largest and strongest connected to the steering mechanism, and the two smaller ones to the gasoline valves and sparking devices.

2. THE CHASSIS AND ITS PARTS

In this picture we look down from above on the chassis or frame of the automobile with all the essential parts in place. At the front we see the radiator, which helps to keep the engine cool. From the engine itself we can trace the "power line" to the rear wheels through the clutch, the gear box, the main drive shaft, and the differential which carries the revolving motion of the shaft into the rear axle. Connected to the engine on one side is the electric generator for charging the storage battery, and the commutator and distributor, which send the electric current to the spark plugs in each of the engine cylinders, timing each spark so the explosions will take place in their proper order. On the other side of the engine is the self-starter, run by the storage battery. The battery, which is not shown here, usually rests under the floor boards or front seats of the car. The exhaust pipe carries the burnt gases from the engine through the muffler which deadens the sound of their escape.

Here you can see the mechanism which connects the steering wheel with the two front wheels of the automobile, as well as the rods which connect the hand and foot brakes with the brake shaft and drums on the rear wheels. The greatest care is used in the manufacture of the framework of the chassis. It is made of steel specially treated to enable it to withstand jars and twists. The greatest danger to a chassis is "crystallization" of the metal, which consists in gradually acquiring brittleness through the constant strains and vibrations, just as a steel wire becomes brittle and breaks if it is repeatedly bent back and forth.

Keeping in mind the general plan shown here, we will now examine the essential parts of the automobile and explain them one by one.

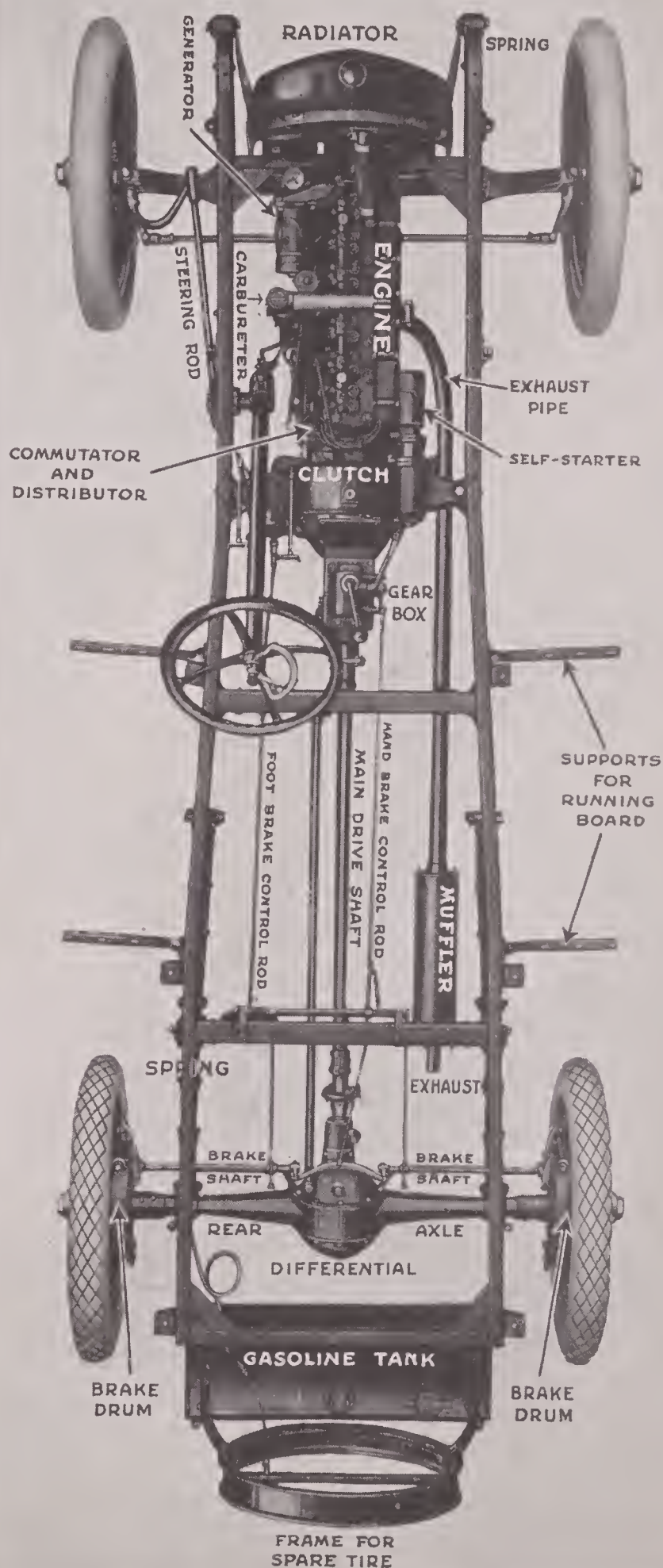


Fig. 2. Stripped Down to "Skeleton and Muscles"

3. THE STEERING MECHANISM

Here we see the front part of the chassis with the engine and radiator removed, showing how the frame is supported by the springs resting on the front axle and how the steering mechanism works. The supports which hold the steering column rigidly in place have been left out, so that we can see the complete operation. The steering wheel has been turned to the right as indicated by the arrow, turning the worm gear also to the right. This forces the quadrant down, and this motion is transferred through the pivot in the frame to the steering arm, which thus moves backward, drawing with it the steering rod. The other end of the steering rod is fastened to the knuckle arm, which projects from the left wheel attachment. The wheel, as you can see, is attached to the axle like a door on a hinge, this entire arrangement being known as the steering knuckle. As the knuckle arm therefore, moves back with the steering rod, the wheel swings on its hinge, pointing to the right. This motion, in turn, is transferred to the tie rod arm, which

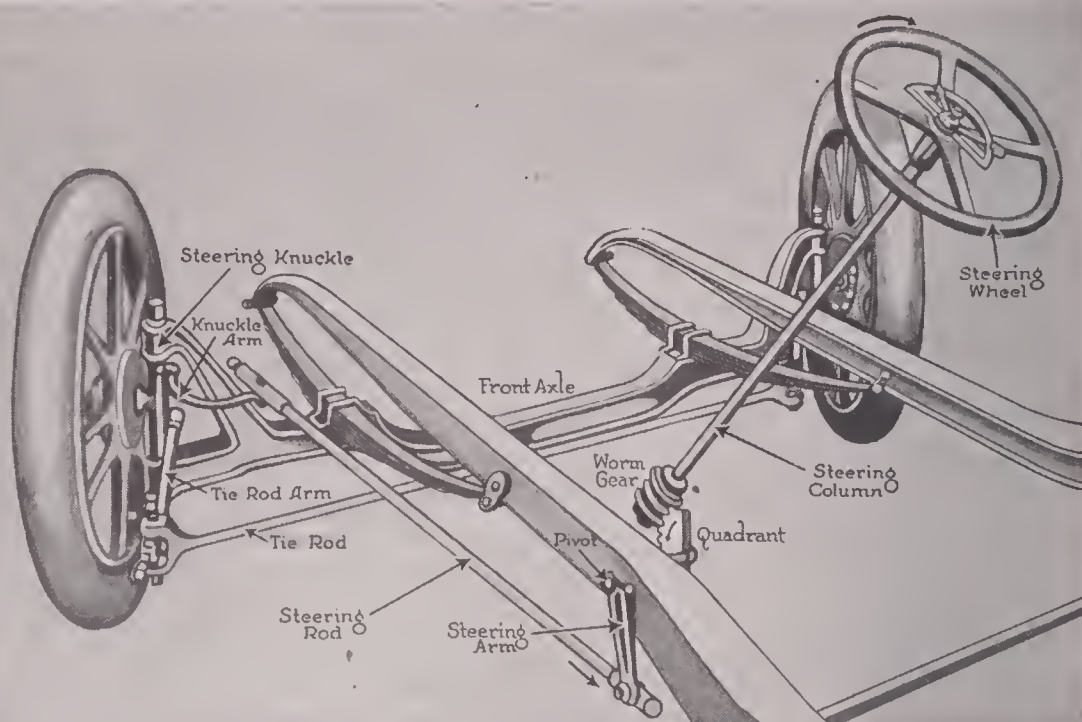


Fig. 3. How the Driver Steers the Car

and point to the right. When the steering wheel is revolved to the left, the whole process will, of course, be reversed.

The details of the steering system vary with different automobiles, but the principles shown here apply to all.

4. THE POWER PLANT

This is the six-cylinder engine, the center of power, shown from the left side, and giving a better view of many of the important parts already noted in Fig. 2. We see how the water pipe connects the hollow water-jacket of the engine to the radiator, and how the fan belt from the engineshaft drives the fan, which draws air through the radiator and sends its cooling blast over all the parts beneath the hood. We see also the position of the timing gear, which is connected inside the engine to the 12 valve rods (two to each cylinder) that move up and down, opening and closing the valves which admit gasoline into the top of the cylinders and let out the burned gases into the exhaust pipe.

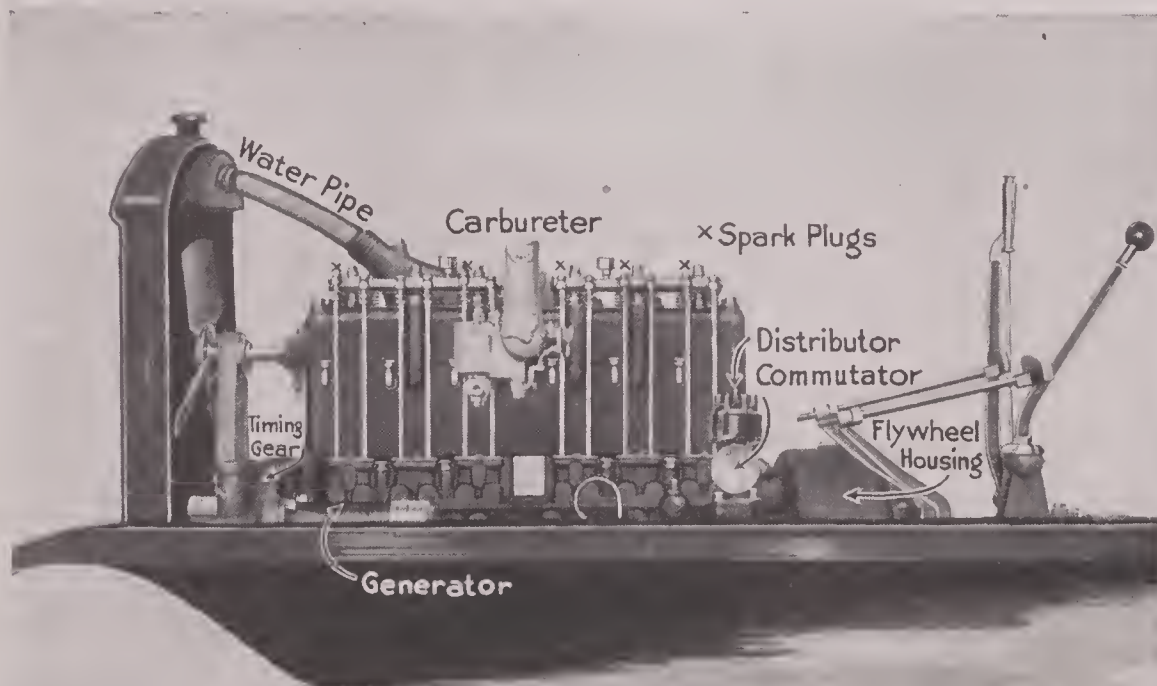


Fig. 4. The "Heart" of the Automobile

is also rigidly attached to the wheel part of the hinge. As this arm swings to the left, it pulls with it the tie rod, which is fastened at the other end to a similar tie rod arm projecting from the hinge of the right wheel. This wheel, therefore, is also forced to swing

The timing gear is delicately adjusted to make each valve work in its proper order, just as the commutator is adjusted for the sparks. When the engine is ready for work, electric wires run from the nobbs or posts at the top of the distributor to the

spark plugs (marked X) on the cylinders. The all-important function of the carbureter is explained with a picture farther on.

When any of these cooling arrangements go wrong, the engine is likely to get so hot that the pistons stick in the cylinders. In cold weather care must be taken that the water in the radiator and around the cylinders does not freeze when the automobile is left standing outdoors, as this may crack the metal.

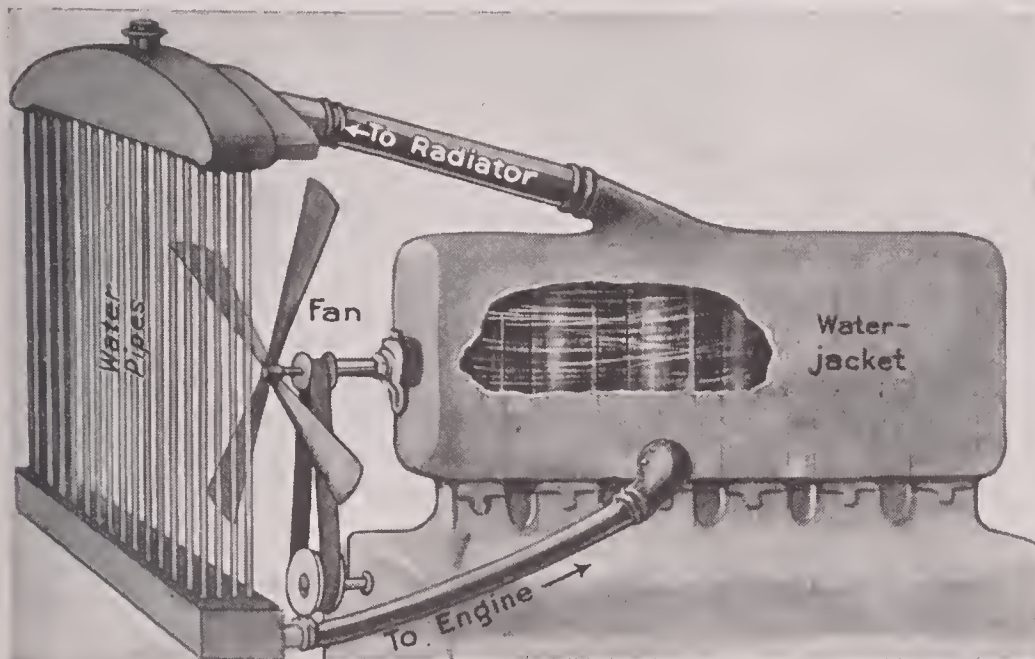


Fig. 5. How the Engine Keeps Itself Cool

5. THE COOLING SYSTEM

We need little imagination to see the danger of a red-hot engine when we think of the constant fire of gas explosions inside the cylinders. To prevent this the radiator is filled with water, which is drawn through the lower pipe by a pump operated by the engine. It circulates around the cylinders inside the water jacket and is forced back to the radiator through the upper pipe. In the simplified diagram shown here, the radiator appears as a number of small straight tubes, conducting the water downward from above. Actually these tubes are arranged in a much more intricate fashion and are covered with countless small projections and flanges which give the greatest possible cooling surface. Some automobiles are air-cooled, depending only on the fan and on the special cooling surface of the cylinders.

6. THE ENGINE AT WORK

Here we have a simplified diagram showing how the gasoline is carried to the engine from the tank at the rear, how it is sucked through the intake valves into the cylinders, how it is compressed, then exploded by the electric spark and how the burned gas escapes through the exhaust valves and exhaust pipe to be expelled at the rear. A four-cylinder engine is used with the side cut away, each cylinder illustrating one of the four steps in the process. We see also how the pistons are forced up and down inside the cylinders and how the piston rods turn the crank shaft and the flywheel. We must imagine that the four steps shown here are repeated in rapid succession in each

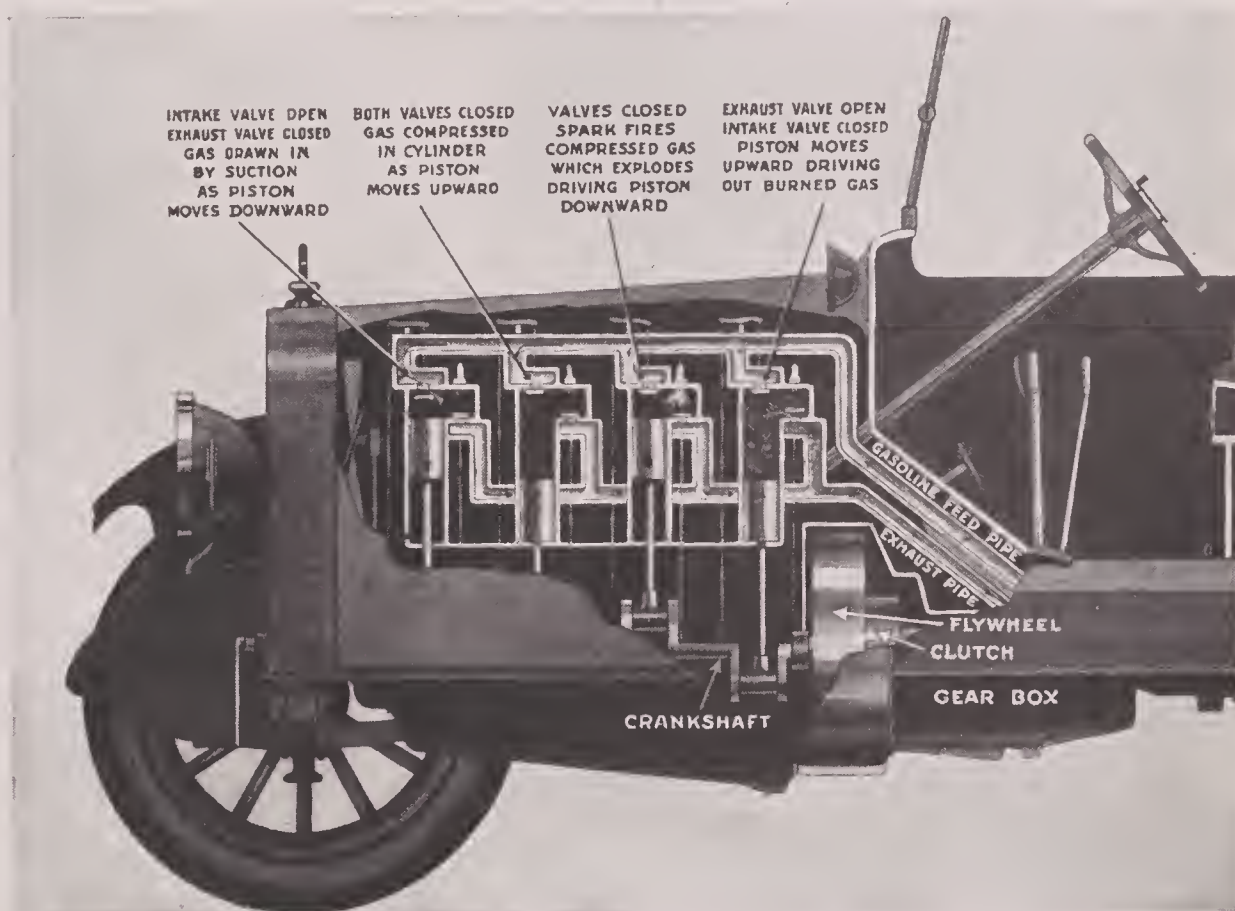


Fig. 6. Looking inside the Engine—the "Heart Beats" of the Automobile

of the four cylinders, or six cylinders, or whatever number of cylinders the engine may have. For the sake of simplicity the carbureter has been omitted from the picture, but its place is on the gasoline feed

pipe, where it turns the liquid gasoline to vapor before sending it into the cylinders. (For a complete account of all these operations see the article on Gas Engine.)

7. WHAT THE CARBURETER DOES

A marvelous little device is the carbureter, where the mixture of gasoline and vapor and air is made, which is to meet the spark inside the cylinders and explode just in time to drive the piston down and work the engine. Although there are many different types of carbureters, the general principles illustrated in this simplified picture apply to them all. The liquid gasoline from the tank is fed into the

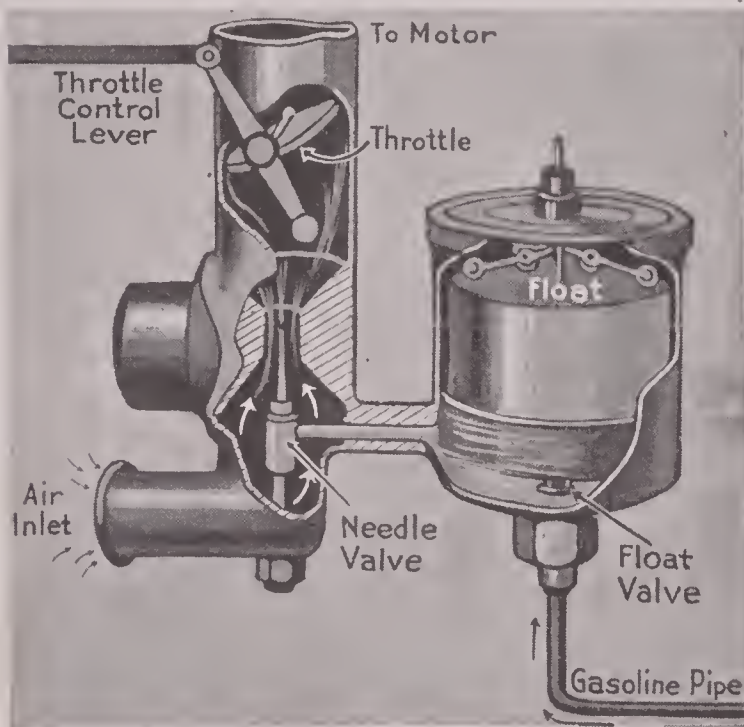


Fig. 7. The "Lungs" of the Automobile

float chamber, either through the simple force of gravity, through pressure in the tank, or through a vacuum suction arrangement. When the gasoline in this chamber reaches a certain level, the rising of the float automatically closes the float valve and cuts off the supply. The gasoline is fed through the needle valve to the spray nozzle, the level in the float chamber being so adjusted that the spray nozzle is constantly filled almost to the tip.

Now, if you will look back at the last picture, you will see that the downward motion of the piston in the first cylinder on the left causes a suction through the gasoline feed pipe. The carbureter is attached to this pipe and receives this suction, which draws air in through the large air inlet. As this air is forced to go through the narrower funnel-shaped opening around the spray nozzle, it travels with great speed and draws the gasoline out through the nozzle in the form of a fine vapor or spray, which mixes with the air, making the explosive gas that is carried through the upper pipe to the engine cylinder. The throttle, which is operated by the hand lever or foot accelerator, as shown in Fig. 1, regulates the flow of air and thus determines the amount of gasoline

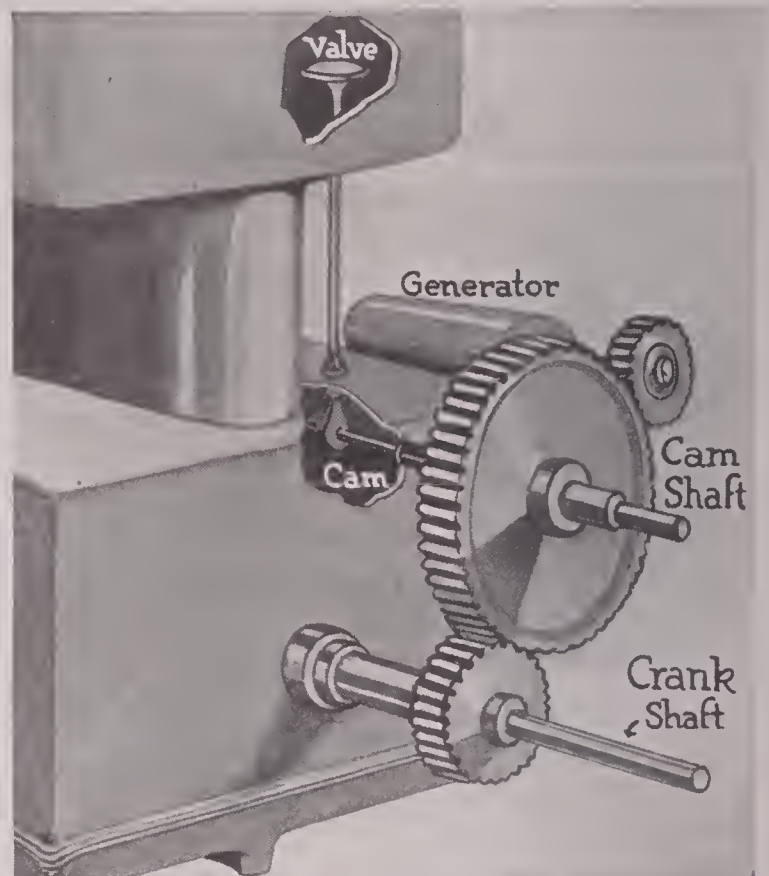


Fig. 8. The Engine's "Clock"

that is drawn from the spray nozzle—the more gasoline in the mixture, the more power, up to a certain point.

8 and 9. THE TIMING DEVICES

Time is everything in an automobile, and things must happen at exactly the right moment. As we saw in Fig. 6, the whole operation of the engine depends upon the opening and closing of the valves at the proper instant. This is regulated by the timing gears shown in Fig. 8. These are situated at the front of the engine, whose crank shaft projects outward. As the crank shaft revolves, the cogwheel upon it turns the cogwheel on the cam shaft. This last shaft gets its name because it has upon it a number of cams, one to each valve. These cams are simply metal projections which revolve with the shaft, and every time they come around on top they push up the valve rod above them and open that particular valve. Fig. 9 shows one of these cams just as it has raised the inlet valve which admits the gasoline. The third cogwheel, shown in Fig. 8, turns the generator which creates the electric current.



Fig. 9. The Little Door that Opens and Shuts

10. THE COMPLICATED CLUTCH

The clutch is a device for disconnecting the engine from the rest of the driving mechanism. We have here the type known as the multiple-disk clutch. To

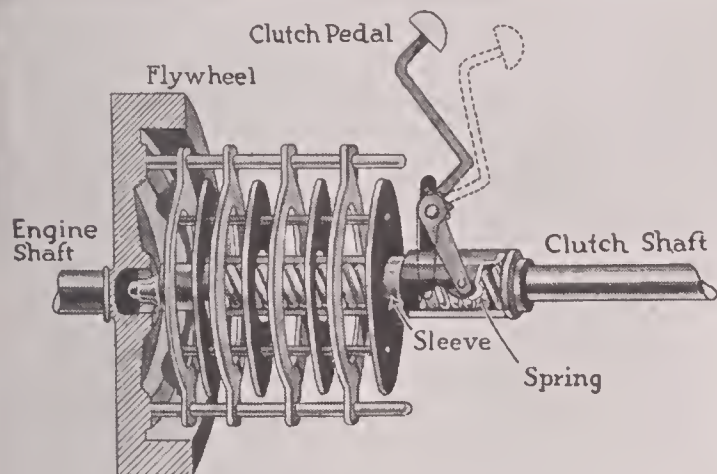


Fig. 10 A. When the Clutch is Out

understand its operation we must realize that the engine shaft at the left is entirely unattached to the clutch shaft at the right, the point where they are divided being just to the right of the flywheel. This makes it possible, when the clutch is out as in Fig. 10 A, for the engine shaft, the flywheel, and the projecting rods supporting the metal rings to revolve without turning any part of the clutch shaft or its attachments. In other words, all the parts which appear *light* in the picture can move independently

of all the *dark* parts. The dark disks are attached to a sleeve which can slide a short distance back and forth on the clutch shaft. They fit between the white rings sandwich-fashion, without touching them. This is the situation when the driver has pushed the clutch forward with his foot.

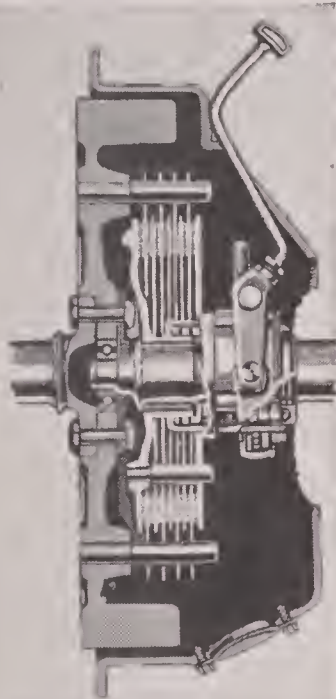


Fig. 10 B. When the Clutch is In

But when the clutch pedal is released, the strong spring inside the sleeve forces the sleeve forward, pushing the edges of the dark disks into contact with the white rings. They clutch one another by the power of friction and the motion of the engine shaft is thus transmitted to the clutch shaft. The faces of the disks and rings are usually covered with leather to make their grip stronger. Figure 10 B shows how all this takes place in an actual clutch, which you will observe is more close fitting than our diagram.

Many cars have clutches of the cone type, in which

a cone-shaped disk is thrust by the spring into a cone shaped hollow in the flywheel, where it locks like a wedge.

The chief purpose of the clutch is to enable the driver while the engine is running to shift the gears as described in the succeeding pictures. When the clutch is let in slowly, it does not take a sudden rigid grip on the whirling flywheel, but slips a little at first, allowing the car to start slowly and smoothly without the sudden wrench which would not only be uncomfortable to the passengers, but which might injure the driving mechanism.

11. THE GEARS—NEUTRAL

Because the gasoline engine gets its power from a series of quick explosions in its cylinders, it must always run at a comparatively high speed. If the engine, therefore, were always connected through the clutch directly to the drive shaft, it would be impossible to run an automobile slowly, which means that

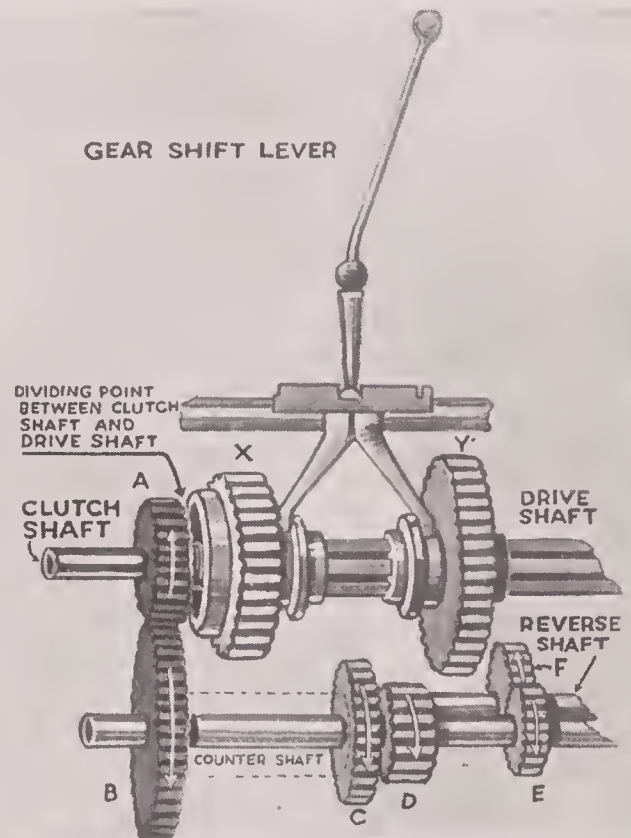


Fig. 11. The Gears in Neutral

it would be impossible to start it, for it must necessarily start slowly and gain speed later. To overcome this difficulty the gear system is used, the chief principle of this system being that, when two cogwheels are meshed or linked together, the large cogwheel will revolve more slowly than the small one. If the large one is twice as big around as the small one, it will make only one turn while the small one makes two turns. This, as we shall see, makes it possible to have the engine shaft revolve rapidly, while the drive shaft revolves slowly.

Let us first look at Fig. 11, which shows the construction of the automobile gear-box. At the left we have the shaft coming from the clutch and revolving at the same speed as the crank shaft of the engine.

To it is fastened the small cogwheel *A*. Beyond *A*, the clutch shaft ends, and there is no attachment between it and the drive shaft. Below we see the counter shaft, on which are mounted the wheel *B*, which is always in mesh with *A*, and the wheels *C*, *D*, and *E*. Beside the counter shaft is the small reverse shaft carrying the wheel *F*, which is permanently in mesh with *E*.

Upon the drive shaft are the two cogwheels *Y* and *X*, which are called sliding gears, because they are able to slide back and forth. They fit down into the grooves of the drive shaft, however, so that when they revolve, the shaft must revolve with them. Finally, we come to the two sliding arms which are operated by the gear shift lever. These arms are loosely fastened to the round collars of the wheels *X* and *Y*, leaving the wheels free to revolve within their grip. As these arms move, they pull the sliding gears closer together and force them farther apart.

As the gear box stands now, it is at "neutral." The wheel *A* is revolving with the engine and turning the larger wheel *B* and all the other wheels on the counter shaft. But the wheels *X* and *Y* are at rest, and the automobile is standing still.

12. THE GEARS—FIRST SPEED

Now we come to the first move the driver makes in getting his automobile under way. He has pressed the

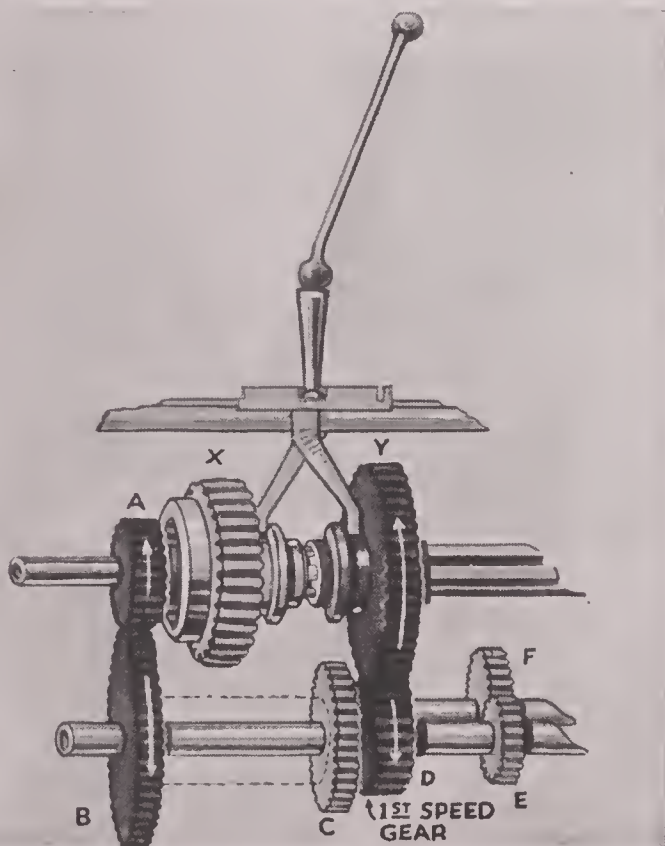


Fig. 12. First or Low Speed

button of the self-starter and set the engine going, and he has pushed in the pedal that throws out the clutch. He now moves the gear-shift lever into the first or low speed position. Fig. 12 shows us what happens in the gear box. The sliding arms are drawn together, moving the sliding cogwheel *Y* forward until its teeth catch or mesh with the wheel *D* on the counter shaft. As soon

as this happens the driver lets the clutch in again, and the car moves forward slowly.

The power from the engine is now passing through wheels *A*, *B*, *D*, and *Y*, the latter turning the drive shaft. The wheels *C*, *E*, *F*, and *X* are revolving idly. If you examine the relative size of the first set of wheels, you will see why this is called the "low speed" gear. Wheel *B*, being much larger than *A*, revolves much more slowly. Wheel *D*, being fastened to the counter shaft with *B*, naturally revolves at the same speed. But *D*, in turn, is meshed with a much larger wheel *Y*, so that the latter turns still more slowly and communicates this low speed to the drive shaft and the wheels.

13. THE GEARS—SECOND SPEED

As the automobile gathers headway, the driver shifts his lever into the position for second or intermediate speed. The sliding arms are pulled very

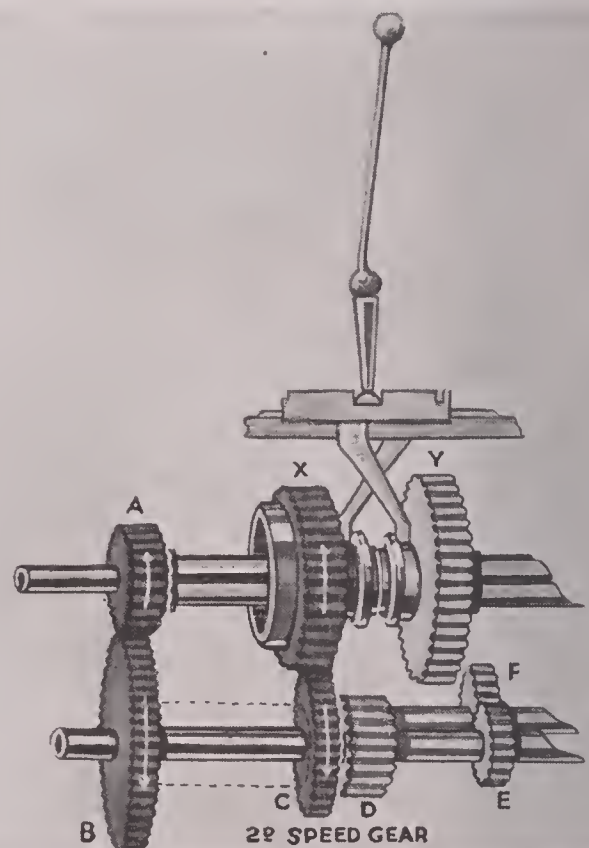


Fig. 13. Second or Intermediate Speed

close together; wheel *Y* moves out of contact with *D*, and wheel *X* moves into gear with *C*. The power is now passing through the wheels *A*, *B*, *C*, and *X*. You will notice that *C* is larger than *D*, and *X* is smaller than *Y*, so that the relative speed of the drive shaft becomes greater than in Fig. 12. In this case the wheels *D*, *E*, *F*, and *Y* are revolving idly.

14. THE GEARS—THIRD SPEED

Now that the automobile is moving quite rapidly, the driver shifts his lever into the third or "high" speed position. To understand this, you must notice a thing we have not mentioned before. From wheel *X* there projects a slightly smaller ring or collar. Around the *inside* of this collar, as you may faintly see in Fig. 13, are teeth made to fit exactly over and around wheel *A*, which projects far enough beyond *B* to afford a grip. When the lever is moved into

"high," therefore, the sliding arms are thrust apart, *X* is pushed out of contact with *C* and moved forward until its collar slips over *A*. The power from the

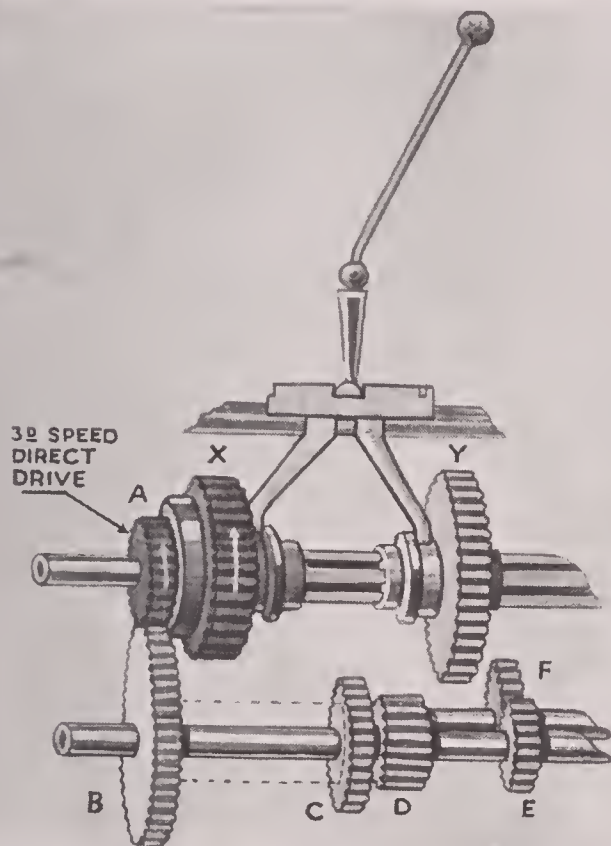


Fig. 14. Third or High Speed

engine now passes *directly* from *A* to *X*, and the drive shaft revolves at exactly the same speed as the clutch

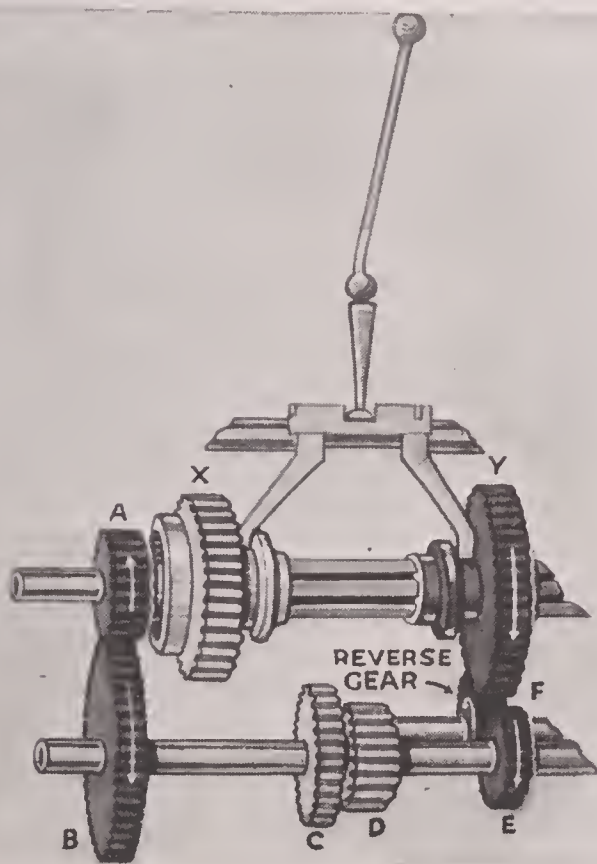


Fig. 15. Reverse

shaft. Once the automobile is "running on high," the increase and decrease in speed is regulated by letting more or less gasoline into the engine.

15. THE GEARS—REVERSE

Perhaps, as the driver speeds along, he has taken the wrong road. He throws his gears into neutral (Fig. 11) and puts on his foot brake to stop. But the way is too narrow to circle about in the regular way. He has to back up to turn around. He throws out his clutch and moves the gear shift lever into the position for reverse. This pushes wheel *Y* back into contact with wheel *F*, which has been all this time idly revolving on the little reverse shaft. The power now passes through wheels *A*, *B*, *E*, *F*, and *Y*. Up to this time the clutch shaft and the drive shaft have always been moving in the same direction, as shown by the arrows. But as soon as that extra wheel *F* is introduced into the power circuit, it reverses the direction of the drive shaft and the car moves backwards.

16. REAR AXLE AND DIFFERENTIAL GEAR

Nearly everything we have seen so far, all the engine parts, gears, wheels, etc., are planned and arranged for one purpose—to deliver as much power, speed, and steadiness as possible to the rear wheels which push the automobile. In Fig. 16 we see the last steps in this process. All other steps have been shown from the left side of the automobile, but to get the proper view, this picture is made from the right side.

The power coming out of the engine, through the clutch and gear box, is turning the long drive shaft. The end of the drive shaft enters the axle housing, which is cut away in the picture to show how this power is carried to the wheels. When the automobile is going ahead, the cone gear at the end of the drive shaft revolves as indicated by the arrow, fitting into and turning the bevel driving gear in the forward direction. This driving gear, however, is not connected directly with the driving wheels, but operates through an ingenious system of cogwheels inside the differential box.

The differential gear, as it is called, is one of the cleverest achievements of mechanical science. Its purpose is to *enable the automobile to turn a corner*. Of course the front wheels, as we have seen, are really the ones that make the automobile turn to the right or left, but the back wheels have an important and even more difficult part to play.

When any four-wheeled vehicle makes a turn, the outside wheels have to travel farther than those on the inside of the turn. Therefore they must revolve faster. Now in wagons and carriages drawn by horses the wheels revolve around the tips of stationary axles, and each wheel can move independently of the other. So there is no difficulty for them in turning a corner. This is true also of the *front* wheels of an automobile. But the *back* wheels cannot be allowed to turn on the back axle. They must be rigidly fastened to it, for it is from this revolving axle that they get their motion and driving power.

Now, if this back axle were one solid piece running clear across the bottom of the car, with a wheel rigidly fastened at each end, it would obviously be impossible

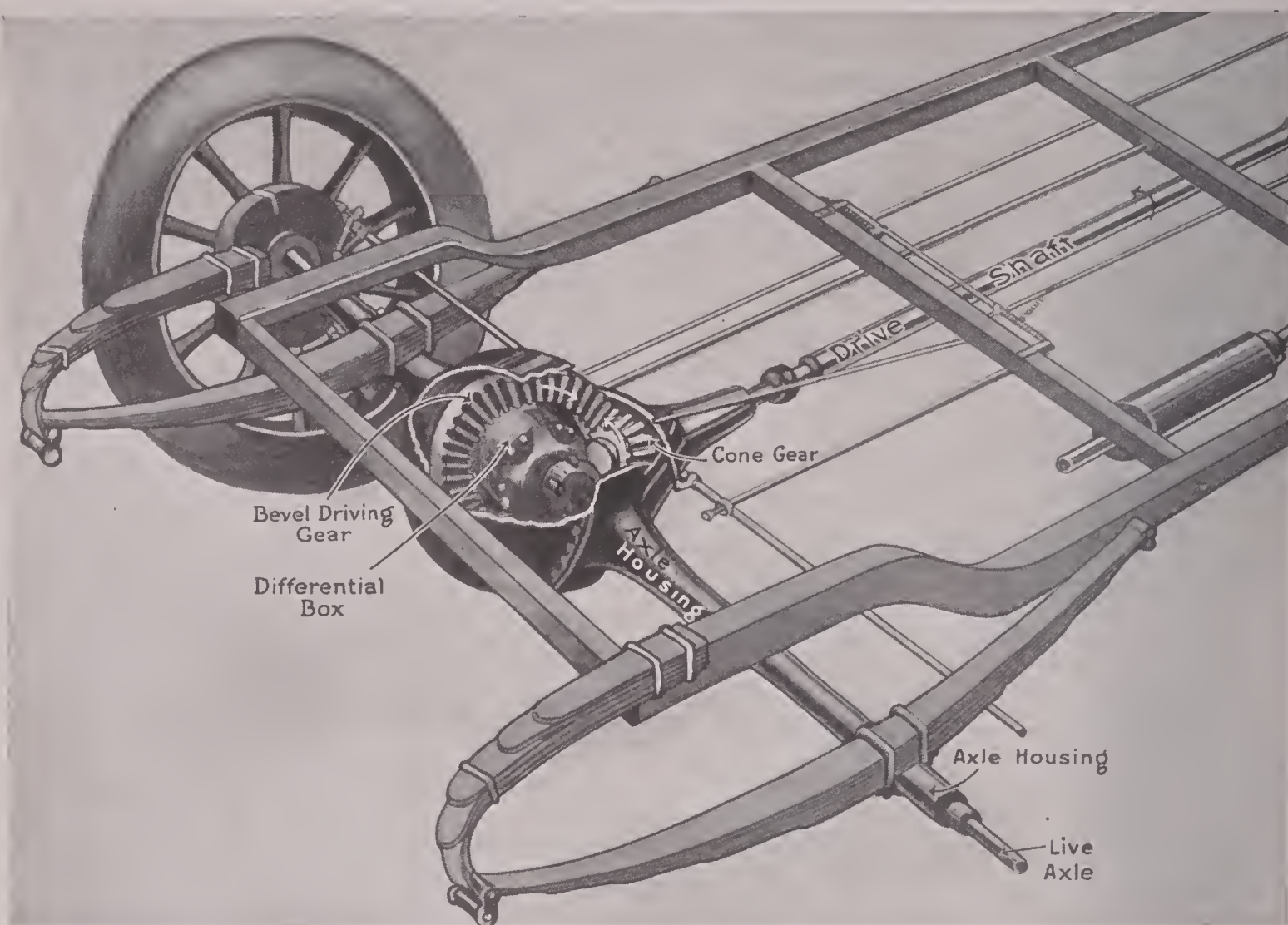


Fig. 16. The Rear Axle—the “Legs” of the Automobile

for one of the wheels to turn faster than the other when making a turn. They would have to revolve at exactly the same speed. To solve this difficulty the rear axle is cut in two in the middle, and between these two parts, which are supported inside the axle housing, the wonderful differential gears work. They make it possible for each half of the axle with its attached wheel to run at different speeds if necessary, without however losing any power. In the picture the right wheel has been removed to show the “live” or moving axle projecting from the axle housing.

Fig. 17. HOW THE DIFFERENTIAL WORKS

The amazing mysteries of the differential gear are exposed in Fig. 17, the whole axle housing and differential box having been removed to show the moving parts inside. If you will study this picture closely you will learn something that many people, even those who drive automobiles, do not understand.

The whirling drive shaft, as we saw in the last illustration, turns the bevel driving gear by means of the cone gear at the shaft’s tip. But here is something we couldn’t see before. Attached to the inside rim of the driving gear are four little pins or spokes. Only three of these can be seen in the picture, but you will notice that each of them carries a small cone-shaped gear, which fits into the bevel gears of the right and left axle.

Here are two important things you must keep in mind. First, these “differential cones,” as they are called, are capable of revolving around their pins or spokes; second, the right and left halves of the “live” axle are not fastened to each other in the middle, but each is a separate rod of steel, with one of the road wheels rigidly fixed on one end, and one of the bevel gears at the other.

When the automobile is rolling down a straight smooth road, the big driving gear moves forward, as indicated by the arrow, and of course carries around with it the pins with the attached cones. And, since these cones are meshed in the two bevel gears on each side of them, these bevel gears must move forward too. Now, when an automobile is going straight ahead, the strain is exactly equal on each of the two back road wheels. Therefore the strain will be equal also on each of the two axle bevel gears, so they will move forward at *exactly the same speed*, and the cones between them *will not revolve*.

Now let the automobile start around a corner. At once, the right rear wheel, having a shorter distance to go in making the turn, slows down. This makes the bevel gear on the right half of the axle slow down also. The big driving gear, however, must keep on revolving at the same speed that it gets from the engine. The little differential cones make this possi-

STRAIGHT AHEAD

TURNING TO THE RIGHT



Fig. 17. The Cogwheels that Seem to "Think"

ble, for they begin also to *revolve on their pins* in the direction shown by the arrows in Fig. 17. In other words, as they are dragged forward by the big driving gear to which they are fastened, they have to roll around on the slower moving face of the right bevel gear.

But remember their teeth are meshed in the left bevel gear as well. Therefore, as they roll around on the right bevel gear, they must naturally push the left one ahead just so much faster. This is exactly what is needed, for we know that when an automobile turns to the right, the left rear wheel has to move faster, just as the right rear wheel has to move slower than it did before. The arrows in Fig. 17 show just how each gear moves as the automobile turns.

By means of these little cone gears, therefore, the speed of the back wheels of an automobile is always balanced. If one wheel slows down a certain amount, the other will move faster by just that same amount.

18. CONSTRUCTION OF THE BRAKES

Often the safety of automobile riders as well as of people crossing their path on foot depends upon the power of the brakes to stop the automobile in time. We saw in Fig. 1 how the two brakes, the service foot brake and the emergency hand brake, were operated from the driver's seat. This picture shows how the former is made to grip the outside of the brake drum on each wheel, when the pedal is pressed down. The brake arm is drawn forward, turning the torsion rod, whose two arms draw the brake rods forward. These pull up the brake levers, which draw the brake bands tight around the drums. Since these drums are fastened to the wheels, the friction forces the whole automobile to slow down at once. The brake band is usually made of flexible spring metal, lined

with leather to increase the friction. The emergency brake is operated through a similar set of rods and arms, which cause brake shoes inside the brake drums to expand. This creates a friction so powerful that it usually stops the wheels abruptly, making them slide over the ground without revolving.

All who have anything to do with motor cars—and that means nearly everybody—should have a clear understanding of the principles set forth above. This

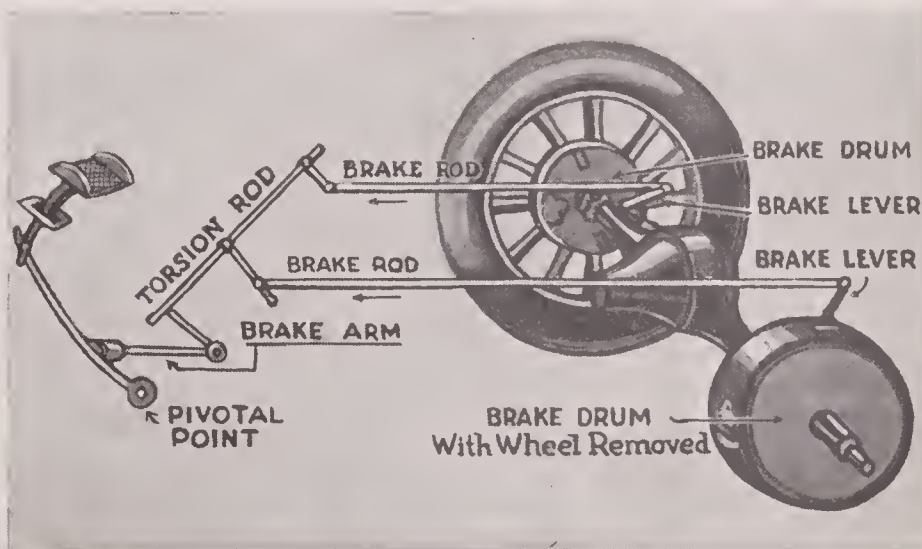


Fig. 18. The Brakes that Often Save Lives

may save many an awkward moment, standing by helpless, perhaps, when a car "breaks down" on a country road. But knowing the theory of an automobile does not necessarily mean that you can drive one properly. That art is acquired only by careful practice, and only those who have learned it from experienced teachers should ever venture to pilot a car through crowded streets or highways. The motto of every automobile driver in handling his machine should always be "Safety first!" Remember that an automobile is an instrument of tremendous power, and that your life—and that of others as well—will depend upon doing instantly the right thing in an emergency.

AVALANCHE. In mountainous regions, where great thicknesses of snow accumulate, huge masses of ice and snow sometimes slide down the mountain sides, destroying everything in their paths. These are called avalanches; smaller masses, such as are common in the Rocky Mountains, are called snow slides.

The most frequent type of avalanche is that which occurs in spring when the snow begins to melt. Although these are dangerous, they are not so destructive to life as are the "wind" avalanches of the winter, because in the spring avalanches are expected and guarded against. In the winter, when the mountain sides are piled with loose dry snow, any slight disturbance, such as accompanies blasting, or even the wind, may start a great mass of snow towards the valley. In the summer "ice" avalanches sometimes occur. These are really parts of glaciers that have become loosened from the larger mass, and fall or slide down a steep slope.

Avalanches carry trees, rocks, houses—everything that comes in their paths. Large forests planted on the mountain slopes sometimes break their force. Heavy walls sometimes are built as a protection.

AZALEA. In April and May the fringy clustered blossoms of this beautiful flowering shrub clothe our low eastern mountains with a vivid mantle of purple, flame-color, rose-pink, or white. Hillside and open woodland glow with their fragrant masses. While most species seek dry, sandy, or rocky soil, the pink azalea, or "wild honeysuckle" grows in low wet places along the eastern coast, and in swampy thickets as far west as Illinois and Texas. This plant is called *nudiflora* (naked), because often the flowers burst into bloom before the leaves have appeared. It is especially loved by small boys who eat the juicy growth that hangs among its blossoms. Closely related to the pink azalea, and found in the same places, is the clammy azalea, a shrub from two to ten feet tall, with fragrant white blossoms appearing in early summer.

Our hot-house and garden azaleas have been cultivated from wild shrubs that grow in the hilly regions of China, Japan, and the countries bordering on the Black Sea. Perhaps the most superb of all is the Ghent azalea, bred by a Belgian horticulturist. "Its soft tints of buff, sulphur, and primrose; its

dazzling shades of apricot, salmon, orange, and vermilion, are always a fresh revelation of color. They have no parallel among flowers, and exist only in opals, sunset skies, and the flush of autumn woods." It is not surprising that this beautiful plant is the national flower of Belgium.

The azaleas are scarcely separable from the rhododendrons. Flowers one and one-half to two inches in diameter with five regular creased lobes spreading out from a long, narrow corolla which is cupped in a small five-parted calyx; one pistil and five long curved pink stamens. Shrub from two to six feet high, branched near the top. The blossoms grow in round-topped clusters on the end of these branches. Leaves long, oval, and tapered at either end, with hairy margins; usually growing in clusters on the stalk. Scientific name of pink azalea, *Azalea nudiflora*; of clammy azalea, *Azalea viscosa*.

AZORES (ă-zōrz'). Midway between North America and Europe lie the nine islands called the Azores, scattered out on the Atlantic Ocean in a line 400 miles long. Flores, the island farthest west, is only 1,300 miles from Cape Race, Newfoundland. St. Michael's Island, at the other end of the group, is 850 miles from the coast of Portugal, the mother country of the Azores. The half-way station thus provided was used by the American navy seaplane which made the first air trip across the Atlantic in May 1919.

These picturesque islands are of volcanic origin and still suffer frequently from earthquakes and eruptions. In 1522 the town of Villa Franca was buried with 6,000 inhabitants. The mild climate and fertile soil, however, produce luxuriant vineyards and orchards, rich open pastures, and wonderful gardens. The surrounding waters are filled with innumerable fish.

The Azores were discovered in 1431 and were at that time uninhabited, though coins were found bearing the stamp of ancient Carthage. Area of the nine islands, 922 square miles; highest point, Pico Mountain on the island of the same name (7,612 feet); principal cities, Ponta Delgada, Angra, and Horta; population, about 240,000.

AZTECS. Never perhaps in the world's history has a race more difficult to understand been discovered than the Aztecs, who lived in central Mexico at the time America was discovered. When bold Cortez with his Spaniards in 1519 reached the valley where Mexico City lies, they found in the midst of a lake an island-city of high towers, temples, and palaces, all white and glittering in the tropical sun, and across the causeways which connected it with the shore streamed busy throngs of brown-skinned people.

This was the city of Tenochtitlan (tā-nōch-tēt-lān'), where lived the great Montezuma, king of the Aztecs and emperor of the Nahua nations, whose rule extended from the Gulf of Mexico to the Cordilleran Mountains, and far into the south toward what today is Guatemala. The civilization there was as far superior to that of the buffalo-hunting Indians of the North American plains and forests as was the civilization of Rome to that of the invading barbarians from northern Europe.

Indeed, the Aztec state resembled the ancient Roman Empire in many ways. Tenochtitlan was



The Azalea

BUILDINGS THAT TELL US OF MEXICO'S VANISHED CIVILIZATIONS



Of the buildings of the ancient Aztecs few remains exist, so thorough was the destruction wrought by Cortez and his men. But we can get an idea of the superb structures of the Aztec builders from the many ruins of Maya architecture still standing in Yucatan, for the Mayas bore many striking resemblances to the Aztecs in art and customs. This is a picture of the so-called Nunnery or Palace at Chichen-Itza. Elaborate carved work embellishes the entire facade. In the center is the figure of a god.

the center of a powerful trade system, with roads stretching to distant provinces. Commerce was protected by a large standing army commanded by the *caciques* or provincial governors, whose duty was also to collect the tribute levied on conquered tribes. The wealth which poured into the capital was used in great part to beautify the city, to spread culture and education, and to encourage the arts of poetry and painting.

Montezuma, who lived in great splendor surrounded by his nobles and served by thousands of slaves, maintained beautiful gardens and menageries filled with rare flowers and animals. On the lake and in the canals which cut through the city were strange "floating islands" made of earth supported on a network of branches and water grass. These were towed from place to place by canoes. On these islands were grown many of the valuable herbs and spices used by the Aztec cooks and the Aztec doctors.

Montezuma is said to have kept a thousand men constantly employed in cleaning and sweeping the

streets and in scrubbing the walls of the temples and palaces until they shone with that dazzling whiteness which so amazed the Spanish explorers.

THE GREAT AZTEC CALENDAR STONE



The most valuable relic of the vanished Aztec culture is this huge Calendar Stone, weighing over 20 tons, discovered in 1790 on the site of the Tecpan or temple enclosure, which once stood on this site now occupied by the civic center of Mexico City. It is believed to have served as an altar on which human victims were sacrificed. In the center is the face of the Sun God. The concentric circles of symbols tell the Aztec myth of the creations and destructions of the world.

Among the Aztecs were expert stone cutters and jewelers, skilled potters, carpenters, architects, and weavers. The latter manufactured beautiful cotton garments, adorned with spun gold, rare furs, and the bright feathers of tropical birds.

A strict and wise system of laws and courts protected the common citizens and even the slaves from many forms of injustice. Crimes and disorder were severely suppressed. Young men who became intoxicated or who squandered their fathers' money were put to death.

From the very cradle children were taught courtesy and self-control. The speech used by the Aztec father when sending his son out into the

world contains advice which might well be given today. "Revere and salute thy elders," he said, "and never show them any sign of contempt. Console the poor and unfortunate with kind words. Do not talk too much and never interrupt others. Eat not too fast and

show no dislike if a dish displeases thee. When thou walkest, look whither thou goest so thou mayst knock against no one. Live by thy work, for thou shalt be the happier therefor. Never lie. When thou tellest anyone what has been told thee, tell the simple truth and add nothing thereto. Be silent in regard to the faults thou seest in others."

Aztec women shared in most of the occupations of the men. They were taught to sing and dance, and some even learned reading and writing, and the principles of astronomy and astrology. And the astronomy of the Aztecs was by no means a crude science. They recognized many of the signs of the zodiac as measures of time, and many of their calendar names bore a striking similarity to those employed by the Chinese. Their calendar dated from the 7th century.

Yet over all this learning and love of beauty and courtesy brooded the shadow of one of the most barbarous and horrible religions the world has ever known. Each year the Aztec priests sacrificed to their numerous gods thousands of human victims. And the flesh of these victims was eaten by the nobles and the people at gruesome cannibal banquets.

The principal aim of the Aztec soldier in battle was not to kill his enemy but to take him prisoner. On the appointed day, the sinister beat of the immense

war drums sounded from the top of the huge tower temple in the center of the city. One by one the prisoners of war were led up the winding stairs around the outside of the temple and were put to death on the altar.

The Aztecs refused to abandon this horrible practice, which they claimed had won the favor of their gods and brought them power and greatness. Cortez overthrew their empire and the idols and temples, and most of the valuable paintings and inscriptions telling of the early history of Mexico were utterly destroyed.

The Aztecs came originally from some country far to the north. It has been suggested that they may have been related to some of the races whose descendants now live in Arizona and New Mexico. They founded

the city of Tenochtitlan about 1325, on the spot occupied earlier by the lost civilization of the Toltecs. With other Nahua tribes, which is the name given to the whole group of invaders from the north, the Aztecs formed a confederacy, later known as the Aztec Confederacy. In this they soon gained the upper hand, subjecting the other tribes to a tyrannical rule. It was largely through the assistance of rebel divisions of the Aztec empire that the Spaniards were able to overthrow the Aztec power. The Indians living in the region around Mexico City today are largely descendants of the ancient Aztecs.

THE AZTEC GOD OF THE WINDS



This is a picture of the Aztec God of the Winds, one of the minor deities of the ancient Mexican mythology. Such pictures as this make up the many interesting "books" which the Aztec priests prepared to record religious festivals and legends and historical events. They had not progressed beyond picture-writing of this crude sort when their civilization was destroyed by the coming of the Spaniards.





Of course you know that's a little king in the cradle—all boy babies are; but probably you don't know that the beautiful woman with that mother love-light in her eyes is Lady Patricia Ramsay, formerly Princess Patricia of Connaught.

Being a GOOD MOTHER *to* BABY

BABY CARE. In one of the dirtiest and noisiest and most crowded parts of a big city lies what is called the Little Mother's School, in which little girls and big girls are taught how to care for their baby brothers and sisters. The little girls and big girls come pretty early in the morning, for the weather is hot and one of the first things they are taught is to keep the baby off the street during the hottest part of the day. Suppose we pay a visit to this school.

Do you notice how happy and well the babies look who have been coming here for a week or two? Some of the new babies who have come this morning for the first time look so hot and unhappy. But the teacher is going to tell the little mothers how to care for those babies, so that they also will crow instead of cry.

"Rosina," says the teacher to a little Italian girl with a very cross baby, "bring your baby here and let's see what is making him cry."

"He's just cranky, teacher," answers Rosina. "He gets cranky days."

No Wonder the Baby Cries

"Now everyone in the class listen carefully," says the teacher. "Here is the first thing for you to learn in caring for a baby. There is no such thing as a cranky baby. If a baby is cross and crying it is a sure sign that something is the matter. Too much or too little food, too much or too little clothing, bunched clothes that make a lump under his little soft back, wet clothes that make him uncomfortable, too little fresh air or too much wind or sun in his face, too much lace and trimming on the baby's clothes or not enough fresh clean ones, all make a baby 'cranky,' as people say. Put yourself in the baby's place and see if you wouldn't be cranky, too."

"Teacher, what is it, then, makes my baby cry?" asks Rosina. Her dark little face is interested and

contained in the Easy Reference Fact-Index at the end of this work

anxious, for her mother is a poor woman and must be away from home working all day, and although Rosina is only ten years old herself, she must be "little mother" to baby and to four-year-old Tony as well.



"Feed the baby at regular intervals."

"How often do you feed the baby?" asks the teacher. "Whenever he hollers!" says Rosina, frankly.

Be Careful of that Dear Little Stomach

"That is one reason he is cranky. Feed the baby only at fixed times. Unless he is sick, and the doctor tells you differently, you should waken the baby at his feeding time. He will soon get used to this and will awake of himself. If you don't do this the baby will sleep past the right time and his meals will come too far apart or too close together.

"Also be sure that all the bottles and dishes from which he gets his food are as clean as they possibly can be. Never give the baby food that has been standing in a warm place or where flies or dust can touch it. Keep the milk in a cool place and never take it out until you are ready to give it to the baby. Babies shouldn't be fed every time they cry and they shouldn't be taken up just because they cry to be taken up."



"Be sure that all the food bottles are as clean as can be."

"Look at his clothes, teacher; look at his clothes. They're all bunched up and the lace is scratching his neck," shouts one little girl.

"That is another thing that is making baby cross,"

said teacher. "All clothes for a baby should be as plain and as soft and as clean as possible. If the clothes are fancy they are much harder to wash and iron and so are not changed as often as they should be. Then the embroidery or lace or ruffles are sure to scratch the baby's soft skin. Besides, the fancy clothes cost more than the plain ones, and the baby doesn't have as many clean ones as he needs. If the dresses and petticoats are made not more than 24 inches long they will not bunch up so easily as the longer ones, they will cost less for material, and they will iron more quickly."

What do you suppose the teacher is going to do with Rosina's baby now? Let's watch and see. All the little mothers are crowding around the table, and Rosina is handing the teacher a bundle. Let's peek into it. Clean baby clothes!



"She rolls up her sleeves and puts her bare elbow into the baby's bath."

You guessed right. The teacher is going to give this baby a bath and teach all these little girls the right way to bathe their own babies.

This is the Way to Bathe the Baby

First, she lays out all the clean clothes. What a funny way she is fixing the petticoat and dress—one slipped inside of the other! This is so that they can both be put on the baby at once, for babies do not like to have their clothes put on and the sooner that part is over the better. Here comes one of the little girls with the baby bathtub, another carries a pitcher of hot water, and another a pitcher of cold. The teacher has a cake of pure white soap, an old blanket, and a soft bath towel. On one side of the table is a can of talcum powder, some absorbent cotton, and a few toothpicks. Imagine toothpicks for a baby who hasn't even one tooth!

The baby is undressed now and lies on the teacher's lap wrapped in the old blanket. One of the girls pours the hot water into the tub and the other one slowly pours the cold and stirs the water around with her hand so that the two will be well mixed.

What a Way to Test the Bath Water!

"Do you know, girls," says the teacher, "I once heard of a woman who said: 'What is the sense of

testing a baby's bath with a thermometer? If the baby comes out red, the water is too hot; and if he comes out blue it is too cold.' Very few people really do have thermometers to test the baby's bath, but I am going to show you a way that answers just as well and is lots easier on the baby than the one that woman used."

"I know how, teacher," offers one of the girls, who has been there before.

She rolls her sleeves above her elbow and puts her bare elbow into the baby's bath. If the water feels neither too hot nor too cold to her elbow, it is just right for the baby. That is certainly easy to remember and easy to do.

Now the baby's head and face are washed and well rinsed and dried while he lies, wrapped snug and warm, on the teacher's lap. Next the soap is rubbed with a soft cloth all over the little body. Now is the time for the swim! Do you notice how the baby is held when he is slipped into the tub to be rinsed? The teacher keeps her left hand under him and his back is leaning against her arm all the time that he is in the tub. Of course with a baby who is old enough to sit alone this is not necessary, but the back of a little baby is so weak that you must be very careful.

Now, You See, the Baby Crows

Now he is lifted—crowing and not crying by this time—onto the blanket again, and the bath towel is laid over him and he is patted dry.



"Give baby plenty of fresh air."

Schedule of the Baby's Hours

6:30—7:00 a. m.	Feeding
7:00—9:00 a. m.	Asleep or awake in bed or carriage
9:00—9:30 a. m.	Bath
9:30—10:00 a. m.	Feeding
10:00—12:30 p. m.	Sleep
12:30—1:00 p. m.	Feeding
1:00—3:00 p. m.	Sleep
3:00—5:00 p. m.	Awake
5:00—5:30 p. m.	Preparation for bed
5:30—6:00 p. m.	Feeding
6:00—10:00 p. m.	Sleep
10:00—10:30 p. m.	Feeding
10:30—6:30 a. m.	Sleep

The above plan for a day for a baby under six months will usually fit into the plans of the average family. The hours may be changed to suit the individual mother, but the important thing is to stick closely to whatever plan you choose.

which is left unhemmed so that there are no hard edges to hurt the baby. The teacher holds her hand underneath while she is pinning this around the baby's abdomen, so that she will not stick him or pin the band too tight. Then the little shirt is put on—one of the kind that has no buttons but fastens by means of two bands brought around and pinned at the back. The diaper, folded smoothly, is pinned to this. Now the stockings are put on and pinned smoothly to the diaper to keep the stockings up and the diaper down. Of course safety pins are always used in pinning anything about a baby.

Notice how the dress and petticoat, one inside the other, are now put on over the baby's feet instead of his head. This does not bother the baby so much and

keeps him happy and smiling after his bath.

And Don't Forget the Toothpicks!

At last we see what the teacher is going to do with those toothpicks we were so anxious about. The ends of four of these are well wrapped in cotton, and very gently the teacher cleans the baby's nostrils and the outer parts of his ears, using a fresh toothpick and cotton for each ear and each side of the nose. Nothing must ever be put in the ear itself except by the doctor's orders.

Just hear Rosina's baby crow and watch him wave his little fat hands! And all the girls want to play with him now and tickle the soles of his little feet to see him laugh. But the teacher says:

"If you want to have a happy contented baby, don't play with him. That sort of play makes him tired and nervous and cross. Let him alone right after his bath or feeding and he will go to sleep by himself and wake up bright as a dollar. Give him plenty of fresh air at all times. In hot weather take him out in the early morning or after the sun goes down, and in windy or very cold weather keep the top of his carriage down so that the wind will



"Never rock the baby to sleep."

"Never rub a baby dry," advises the teacher. "Pat with the towel until he is well dried, and then powder all the little creases and folds of his skin."

Then comes the dressing of the baby. If a flannel band is used, it is made of a piece of torn flannel

not blow in his face. If he is well wrapped up and protected from the wind he can sleep in his carriage out on the porch even in winter. And *please* don't rock or wheel him to sleep, because he will sleep better if he is left alone and won't get into the bad habit of waking up at night to be rocked. And never, *never*, NEVER give him any soothing syrup or other medicines without the doctor's orders; or feed him tea, coffee, pickles, and other things which are all right for grown-ups but are very bad for babies."



"Never give him any medicine without the doctor's orders"

And now the School for Little Mothers is over for today, and Rosina takes her sleepy, happy baby home for his nap. The other girls take their babies home to bathe them and make them comfortable, and we and the teacher have the room to ourselves.

Get out a pencil and some paper and we can copy the things that she has written on the blackboard for the girls, for these lists of books and rules may help us some day when we have the baby to care for while mother is away. Besides, mother might like to see what you learned from your visit to the School for Little Mothers.

The following books on baby care will be found useful: 'Prenatal Care' and 'The Care of the Baby'—two excellent pamphlets published by the United States Child Welfare Bureau, Washington, D.C., and sent free on request. Many state Boards of

Health—especially the one of Minnesota (Minneapolis, Minn.)—publish for free distribution excellent booklets on the feeding and care of children. The following can be ordered from any bookdealer: 'The Care and Feeding of Children', by Emmett Holt, M.D. 'The Care of the Baby', by J. P. C. Griffith, M.D.

LAYETTE FOR THE BABY

Three part-wool shirts (second size)
Three part-wool petticoats (Gertrude style)
Eight slips or simple dresses
Four pairs part-wool stockings
Four outing flannel or thinner night-gowns

Two long wrappers
Two short knitted or flannel sacks
One coat
One hood in winter, or two in summer
Four to six small cotton blankets
Three flannel binders, torn 20 by 6 inches and left unhemmed, or four

knitted binders. (Many doctors now advise leaving off the binder entirely after the first four weeks.)
Forty-eight or more diapers, torn 18 by 36 inches or 20 by 40 inches.
Birdseye diaper cloth is best.

BABYLON. What London and Paris and New York are to the modern world, the city of Babylon was to the ancient. It was the capital of ancient Babylonia, situated on the Euphrates River about 70 miles south of the present Bagdad. Babylon was one of the oldest of cities, as we find it mentioned in records now more than 5,000 years old (about 3800 B.C.). But during the first thousand years of its known history, it was a mere village and played little or no part in the history of the region.

At the height of its glory Babylon was one of the greatest and most magnificent cities in the world. It was built in the form of a square, and was enclosed with brick walls of great height and thickness, defended by numerous towers. Its temples and palaces were adorned with glazed bricks and tiles picturing scenes from Babylonian history and religion. The "hanging gardens" of Babylon, built in terrace form and supported on arches which rested upon other arches, were one of the seven wonders of the world. In later days the name Babylon became a synonym for worldliness, luxury, and vice.

But Babylon was noted also as a seat of learning, education, and art. Excavations on the site by European scholars have revealed rich art treasures and many other interesting objects. Among these are the remains of a schoolhouse more than 4,000 years old—from the time of King Hammurabi. The building consisted of a number of rooms, with walls of sun-baked brick, built about an open courtyard.

On the floor were still lying the clay tablets of the pupils, with the exercises which they wrote on them more than 4,000 years ago.

What was school like in those long-ago days? The principal study was learning to form the wedge-shaped characters which we call cuneiform (*cū-nē'-i-form*) writing. It was necessary for the Babylonian boy to master three or four hundred different signs, instead of the few signs which make up our alphabet. Each pupil was given a tablet covered with soft clay, on which he wrote with a reed stylus. When the tablet was filled he could smooth out the marks with a flat stick or stone, or could make himself a new tablet with a fresh ball of clay.

In learning to write the pupil first made long rows of single wedges in three positions—horizontal, vertical, and oblique. When he could make the single wedges neatly, the master set him to work on the wedge-groups which form the signs themselves. Then he undertook words and phrases, and finally whole sentences and quotations.

The art of writing was very highly valued by these ancients. One of their proverbs reads: "He who shall excel in tablet-writing shall shine like the sun."

Babylon became the capital of all Babylonia about 2350 B.C. Various Assyrian kings attacked and conquered it, and in 689 B.C. its walls, temples, and palaces were razed to the ground because of a revolt against Assyrian rule. The city was soon rebuilt, however, and flourished for a time under independent rule. It rapidly declined when conquered by the Persians (538 B.C.). In 275 B.C. the remaining inhabitants were removed to a new city called Seleucia.

EMPIRES *that* FLOURISHED WHEN *the* WORLD WAS YOUNG

BABYLONIA AND ASSYRIA. Scholars are unable to tell us whether civilization first arose in Egypt or in that part of the valley of the Tigris and Euphrates rivers of western Asia which we call Babylonia. At all events, here lay one of the earliest cradles of civilization.

Long before 3000 B.C., the predecessors of the ancient Babylonians (called Sumerians) were living in tiny city-states along the lower course of the twin rivers, in small towns built of sun-dried bricks. They irrigated their barley and wheat fields by extensive canals, and they wrote letters and kept records on tablets of baked clay by means of their curious wedge-shaped "cuneiform" writing. They used a system of counting by 60's instead of by 100's, from which has come our division of the hour into 60

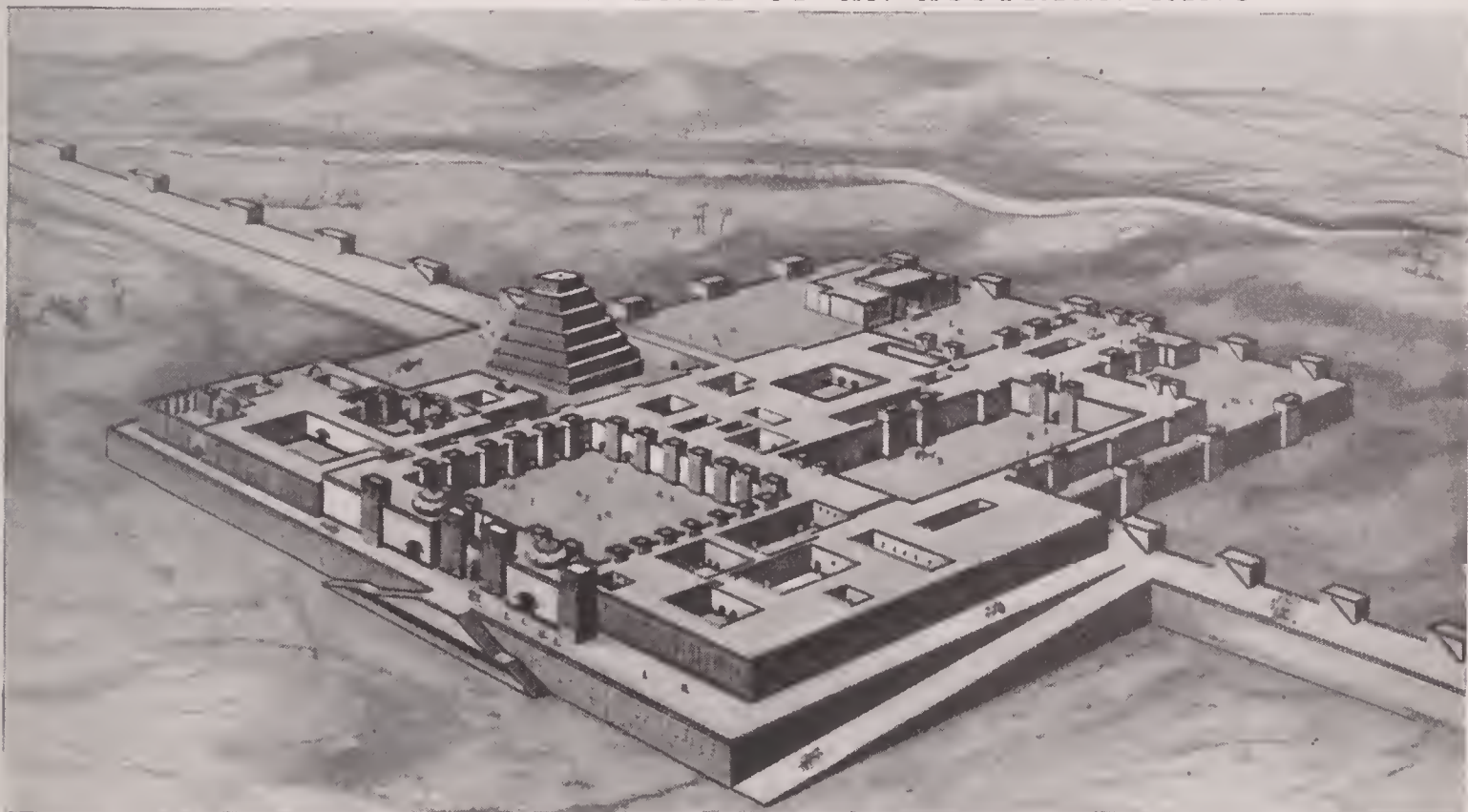
GREAT sculptured slabs of stone and glazed-brick pictures of lion-hunting kings, as well as whole libraries of baked clay tablets filled with the literature and learning of far-off times, attest the greatness of the civilization which flourished 5,000 years ago in the valley of the Tigris and the Euphrates rivers—where legend locates the site of the Garden of Eden.

around it, and the period 3050 to 2750 B.C. is known as the Age of the Sumerian City Kingdoms. The inhabitants had come from what are now the mountains of

Persia, to the east, and apparently were not related to any of the groups of people that we now know. The petty states were constantly warring with one another. They also had an outside enemy to meet in the wandering Semitic tribes of the Arabian desert to the west. Finally one of these Semitic chieftains from the desert, named Sargon, proved too strong for the Sumerians, and made himself master of the whole plain.

Sargon (about 2750 B.C.) was the first great leader in history and the first to build up a great nation. His kingdom soon reached from the Persian Gulf to the Mediterranean Sea, and gradually his nomadic

THE ROYAL RESIDENCE OF AN ASSYRIAN KING



Sargon II, king of Assyria, built this palace on a great elevated platform covering 25 acres, with inclined roadways on which he could drive up his chariot from the streets of the city below. Numerous courts furnished light to the surrounding rooms and halls. Such temple towers as that behind the largest court developed into the spires we see on churches today.

minutes and of the minute into 60 seconds. In the center of the Plain of Shinar (as Babylonia was then called) rose a great tower on a temple, which is regarded as the original Tower of Babel and the remote ancestor of our modern church steeples.

The Dawn of Civilization in Babylonia

Each one of the little towns of the Plain of Shinar in that early day owned the land for a few miles

followers dropped their unsettled life and took up fixed abodes in the plains. They adopted the civilization of their former enemies, gaining new arts of peace and of war. They learned to make helmets of leather and copper, which are the earliest known examples of the use of metal for protection in war. From this humble beginning evolved the armor of the medieval knights, and our steel-clad battleships.

HOW ASSURBANIPAL SLEW THE LIONS



This fine example of Assyrian animal sculpture records the prowess of Assurbanipal, last of the great Assyrian emperors. The rider of the horse in the rear, after having planted three arrows in the body of the king of beasts, has fallen. In depicting the human figure, the Assyrian artists were monotonous and formal, but they were remarkably successful in their modeling of animals.

As the kings who followed Sargon slowly weakened, a new desert tribe of Semites invaded the land, and in turn established the kingdom of Babylonia, so named from its capital Babylon, which now arose to supremacy. Under the great ruler Hammurabi, about 2100 B.C., this new kingdom reached its height. Agriculture was extensively practiced, commerce flourished, and law and government were highly developed.

The cities which composed Hammurabi's kingdom have long been mere deserted mounds of earth and crumbled brick. But amid these ruins scholars have recently found over 50 baked clay tablets containing letters written by this king, and also a shaft of stone containing the priceless record of his laws. These writings enable us to bridge the gap of more than 4,000 years which separates us from Hammurabi's time and to reconstruct in part the daily life of his people.

Hammurabi's letters contain orders directed to officials in different parts of the kingdom. He orders the river Euphrates cleared of its obstacles to river commerce. Taxes must be collected and delinquents punished. Unjust judges and corrupt officials are brought to justice. The spring sheep shearing is

ordered to be celebrated as a great feast. Other letters deal with the temples and religion, the regulation of the calendar, and similar matters.

ASSYRIAN SOLDIERS OF THE EMPIRE

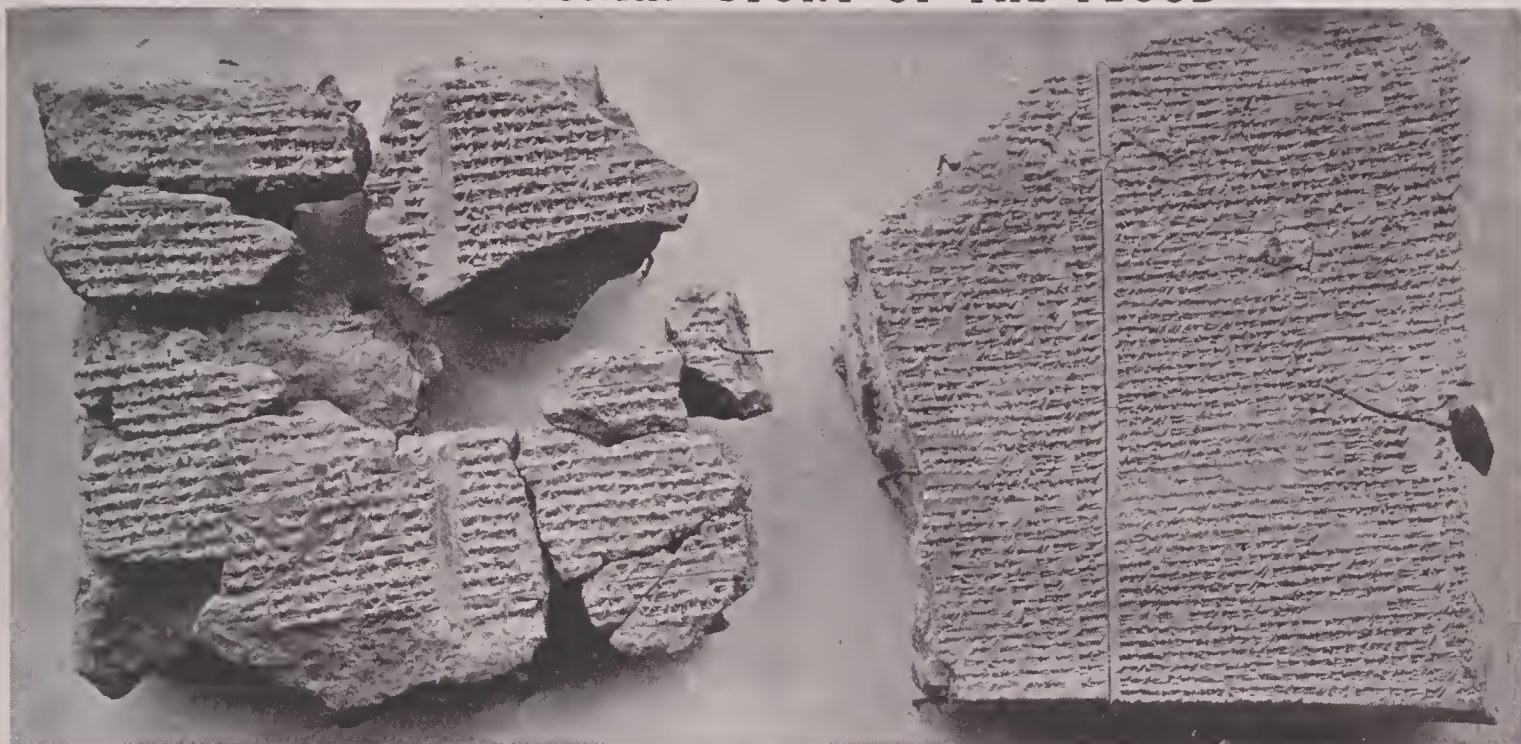


Such brawny men with spear and bow made Assyria the supreme power in the East. The great armies of the Assyrians were the first to be equipped with weapons of iron and the first to use the battering ram. It was men so armed that "came down like the wolf on the fold."

The laws of Hammurabi, chiseled in wedge-shaped characters on their shaft of stone, are the earliest code of law for any people which has come down to us. They are thus a priceless aid to making clear the earliest life of civilized man, long before the days of ancient Greece and Rome. In them we find a highly developed political and social system. There were three classes in the community—a ruling class of nobles and officials, a middle class, and slaves. Much attention is given to commerce, money, and banking, as well as to agriculture and the canals and ditches needed for irrigating the soil. Justice was insisted on for the widow, the orphan, and the poor, but punishments were usually based on the principle, "an eye for an eye and a tooth for a tooth." For example, if a house fell through the crumbling of its sun-baked bricks and killed the son of the householder, the guilty builder must also suffer the loss of his

son. The position of women in these laws was a high one, and they are shown as frequently engaging in business on their own account.

THE BABYLONIAN STORY OF THE FLOOD



On these baked clay tablets, which are among the priceless historic treasures of the British Museum, is inscribed, in cuneiform letters, the Babylonian story of the Flood. These clay pages are from the library of King Assurbanipal. Apparently people carried off other people's books and made marks in them in those days just as they do now, for the king had a bookmark calling down the wrath of heaven on anybody who did any of these things to the books in his private collection.

After Hammurabi's death his kingdom went to pieces. The wild tribes again descended from the eastern mountains to the plains, this time bringing with them a strange animal which the Babylonians called "the ass of the East," but which we call the horse. The newcomers failed to benefit from the civilization of Babylonia; instead, their ruder ways became the ways of the plains. Even the old Sumerian language was forgotten and a Semitic language, related to the Hebrew of the time of Christ, took its place. Babylonian progress was effectually stopped.

But in the northern part of the Tigris-Euphrates valley there had arisen a new nation called Assyria, from its chief town, Assur. At first Assur was a small city-state like those of Babylonia in the south, and it was usually under the control of its powerful Babylonian neighbors, from whom its people borrowed the calendar, writing, sculpture, and other improvements of civilization. By continual strife with their more advanced southern neighbors, and with the wild tribes to the north, the Assyrians gained skill in warfare, until they finally aspired to rule not only the valley of the two rivers but wider stretches to the west.

Before Assyria had reached this goal, however, there had arisen new rivals to its power. These were the little kingdoms of Palestine and of Syria, situated in what is called "the fertile crescent" which links Mesopotamia with Egypt. Syria especially was rich

THE MIGHTY PHALANX ON THE MARCH



The phalanx—a massed group of fighting men—which the Sumerians first introduced into the art of war, was one of the secrets of their success. Here we see a phalanx with the king at its head, and with spears set for the charge. The men's heads are protected by leather caps, and they have tall shields covering their entire bodies.

in bustling cities, carrying on extensive commerce with all of the known world and spreading their system of writing—the first system to make practical use of an alphabet—far and wide. For a time these cities checked the advance of the Assyrians, and it was not until the middle of the 8th century before Christ that Damascus, the most powerful city of Syria, fell.

The conquest of the others soon followed, when, as the poet Byron tells us—

The Assyrian came down like the wolf on the fold,
And his cohorts were gleaming in purple and gold.

Assyria not only conquered Syria and Palestine, but her rule for a time extended even into Egypt. Two things contributed to this military success—first, the Assyrians were the first people to learn the use of iron weapons; and second, the organization of their whole state, like that of the later Prussians, was based on war and conquest. Like the Prussians,

also, their rule was one of "blood and iron." One Assyrian king, Sargon II (722-705 B.C.), destroyed the northern kingdom of the Hebrews (called Israel) and carried away as captives part of its people.

Sargon's son Sennacherib (705-681 B.C.) destroyed the ancient city of Babylon, and even turned the waters of the canal over its ruins. Sargon II had built for himself a palace far surpassing anything yet built; the building covered 25 acres, and the inclosure was large enough to shelter 80,000 people. But this was not enough for Sennacherib, and he built as his capital the proud city of Nineveh, on the upper course of the Tigris. Within the palace halls were long stretches of pictures of the emperor's conquests, cut in alabaster slabs. The men in these reliefs all looked alike, except that the king was distinguished by his curled hair and beard; and they were all devoid of expression. But the animals on slabs picturing lion hunts and the like were very natural, and on the whole the art was far in advance of the art of the Babylonians. Literature advanced with art, and there is now in the British Museum in London a great collection of 22,000 clay tablets which have been discovered in the ruins of the ancient palace of Nineveh. This is the earliest library of which we know, and in it were religious, scientific, and literary works, all carefully catalogued.

In the gardens of the palace were all manner of strange trees, including "cotton trees that bore wool which was clipped and carded for garments." These "cotton trees" are thought to be a tall species of the cotton plant which grows in our own southern states today.

Interest in literature, art, and industry, however, was only incidental. The Assyrian Empire was still essentially military, and as conquest succeeded conquest it became more so, for a large army was needed to keep in subjection the conquered peoples. These subject peoples constantly grew more restive, for not only were they governed and taxed by the emperor at Nineveh, but they were forced to help him fight his battles.

The Chaldean and Persian Empires

The end of the Assyrian Empire came in 606 B.C. A desert tribe called Chaldeans had been slowly creeping in from the south and had overrun Babylonia.

Then they joined with the Medes, a tribe from the mountains to the east, and assailed Nineveh, the mighty city of Assyrian kings. The rejoicing of the world at the fall of Nineveh was expressed by the Hebrew prophet Nahum, who said: "All that hear the news of thy fate shall clap their hands over thee; for whom has not thy wickedness afflicted continually." Two hundred years later the Greek historian Xenophon could not even learn the name of the crumbling ruins where once had stood the proud city of Nineveh (see Nineveh).

The new masters of the Tigris-Euphrates valley rebuilt the old city of Babylon and made it their capital. Here for over 40 years (604-561

B.C.) ruled Nebuchadnezzar, greatest of the Chaldean emperors. He enlarged the city and built enormous walls about it to protect it from its enemies. His palace surpassed in beauty that of any former ruler, and to please his wife he constructed the wonderful Hanging Gardens of Babylon, which the Greeks counted one of the Seven Wonders of the World. This is the Babylon described in the Bible as the city of the Hebrew captivity, for after one of their many revolts Nebuchadnezzar had destroyed Jerusalem and carried away the people into captivity.

Under the Chaldean or second Babylonian empire commerce and industry flourished, and literature and the arts were developed. Special progress was made in the science of astronomy, for the Chaldeans mapped out the sky into the 12 signs of the zodiac, and they knew the five planets, Jupiter, Mars, Venus, Mercury, and Saturn.

But the days of the Chaldean Empire were numbered, as Daniel told Belshazzar in the interpretation of his dream, and soon its lands were divided between the Medes and the Persians (538 B.C.).

This was the end of the great civilization of the Tigris-Euphrates valley, whose checkered course stretched far back down the corridors of time. It is strange to think that we are nearer today by a thousand years to the fall of the Chaldean Empire than were the Medes and Persians of that day to the faint far-off dawn of Babylonian civilization, over 3,000 years before, on the river plain of Shinar. With the

WHERE ASSYRIA SPREAD HER EMPIRE



On this map you can trace the story of the short-lived Assyrian empire from the days of its founder, Sargon II, to its greatest extent 80 years later under his grandson Assurbanipal (called Sardanapalus by the Greeks).

fall of Babylonia the course of empire started definitely on its westward way.

Since that time Mesopotamia has always been subject to some foreign people—the Persians, Greeks, Romans, Arabians, or Turks. The latest chapter in

its history was written in the World War of 1914-18, when British and Arabian troops wrested Bagdad from Turkish misrule, and again made possible works of irrigation and development by which the valley desert may once more "blossom as the rose."

Babylonian Myths of Life and Death

Tales, Resembling the Stories of Our Bible, that the Mothers of Babylon Told Their Children Ages Ago



ORE than 2,000 years before Christ the ancient Babylonians had many quaint myths to explain the mysteries of life and death and man's history on earth.

These myths were doubtless still told among the Babylonians more than a thousand years later, when the Jews dwelt for 70 years as captives in that land.



So we can find traces of these stories in the Old Testament, and we also have the Babylonian stories themselves preserved in the quaint old wedge-shaped characters of their records.

The Shepherd who Soared to the Skies

One of these Babylonian stories tells of the wonderful adventures of a shepherd named Etana (*ā-tā'nā*), who was the first of mankind to attempt to fly. It happened once that his flocks were stricken with unfruitfulness, so that no more lambs were born. But he learned of an herb in heaven which was the source of life; and to obtain this and cure his flocks he induced an eagle to carry him on its back to the highest heaven.

The first gate was successfully passed. Then the eagle, bearing its shepherd passenger, mounted to yet dizzier heights. Its strength, however, now began

to fail, and just as Etana neared his goal, both he and the eagle were hurled to earth by the jealous gods, and perished.

The Man who Refused Immortality

The mystery of death is dealt with in the story of the fisherman Adapa (*ā'dā-pā*), who was one of the first men created. While he was busy at his trade one day, the South-wind goddess overturned his boat, and Adapa in a rage seized and broke the goddess' wing. For this he was summoned before the throne of the Sky-god. When Adapa told of the mischief the South-wind had done him, the Sky-god excused him and even offered to him the heavenly bread and water of life. This would have made him immortal and destroyed death. But Adapa was suspicious and refused to eat or drink while in heaven, fearing that it was the bread of death and not of life. He thus lost both for himself and for mankind the precious gift of immortal life. Some scholars see in this Babylonian reference to the "bread of life" a resemblance to the Biblical "tree of life" planted in the Garden of Eden.

Babylonian Story of the Flood

Several Babylonian and Assyrian records tell of a great flood which once covered all that land, and how a man named Ut-Napishtim (*ōōt-nā-pīsh'tīm*) and his family were saved by the favor of the gods.

The deluge is represented as sent upon the earth as a punishment for the sins of men. Ut-Napishtim, the Babylonian Noah, was warned in advance by the god Ea, who gave directions for the building of a great ship with strong roof or deck, in which "the beasts of the field and the birds of heaven" might be saved along with the hero and his family.

Then thunder, lightning, and rain came, with a hurricane which drove the waters of the deep over the land. After seven days the floods began to subside. Ut-Napishtim sent out from his ship in succession a dove, a swallow, and a raven. When the raven came back with signs of mud on his feet, he knew that the land was beginning to appear. The ship is represented as coming to rest on the highest peak of eastern Kurdistan, instead of upon Ararat, as

in the Bible account. Ut-Napishtim is then made immortal by the gods.

In its best-known form this Babylonian account is part of a long poem covering twelve tablets, found in the ruins of Assurbanipal's palace at Nineveh. It is called the "Epic of Gilgamesh." Ut-Napishtim tells the deluge story when the hero Gilgamesh visits him in a wonderful land across "the waters of death," as an explanation of his perpetual youth.

BACCHUS. The Roman name for the mythological divinity whom the Greeks called Dionysus. (See Dionysus.)

BACH (*bāk*), JOHANN SEBASTIAN (1685–1750). By the light of the midnight moon a young boy sat copying from a great manuscript music-book spread before him. He strained his young eyes to see the notes, and stopped at times to stretch and rub his cramped little fingers; but he made no sound. The moonlight passed, and with a sigh the great book was noiselessly returned to its shelf. The copy was then carefully hidden and the little copyist crept to bed.

This 12-year-old boy was Sebastian Bach, an orphan. His brother, who was his guardian and music-master, had refused him the use of the book, telling him that its music was too difficult for one so young. But with a great music-love that would not be denied, the boy spent night after night secretly copying the coveted scores—working harm to his sight that resulted in blindness during his last years.

The whole life of this German musician was filled with incidents that show just such devotion to his art. When he was a choir boy he spent all his recreation hours at the organ or clavier. When he was able to fill the position of organist, he saved and scrimped, and traveled many miles on foot to hear and to study with the greatest organists of the day. In later years, although his duties as choirmaster in Leipzig made demands that might have kept two musicians busy, Bach found time to compose choral, organ, and piano pieces that were to become "the most universal force in the development of music." To the last days of his life, even when totally blind he dictated the choral, 'Herewith I Come Before Thy Throne', the passion for music governed his whole life. The 'Well-tempered Clavichord' was written for the instruction of his sons, and some of his finest cantatas were composed for his wife and daughter to sing.

In the musical life of Germany the name of Bach had long been known, and for six generations this family had furnished noted musicians. Sebastian Bach was recognized both as the greatest of all this musical line, and as one of the greatest organists and clavier players of the day.

In his time he was not generally known as a composer, and almost a hundred years passed before his music was widely published and appreciated. Now critics find no phrase too extravagant to describe the place his compositions fill in the literature of music. Bach has been described as "the man who suddenly

surpassed all that had been done before him, while at the same time anticipating all that was to be written in the future." The greatest of modern musicians have acknowledged their indebtedness to him.

Bach perfected the tuning of the clavichord, as the early piano was called, so that a new scale could be commenced on any note in the octave. It was also Bach who first taught musicians to use all five fingers in playing keyed instruments. His stately chorals and grand choruses have never been surpassed, and his orchestral music is remarkable for the richness of its harmonies. In Eisenach the house in which Bach was born has been made into a Bach Museum.

BACON, LORD FRANCIS (1561–1626). Next to Shakespeare, the greatest intellectual figure in the wonderful Elizabethan Age of England was Sir Francis



LORD BACON
Philosopher and Statesman

Bacon, who was made a peer under the titles Lord Verulam and Viscount St. Albans. Though a great philosopher, statesman, and jurist, Bacon was not always a great man. He showed at times some of the baser characteristics of human nature, including ingratitude (so it was charged) to his patron, the Earl of Essex; so that the poet Pope un-

justly styled him "the wisest, brightest, meanest of mankind."

By birth Bacon had many advantages. His father was Lord Keeper of the great seal of England, and so his boyhood was spent at Elizabeth's court. At 12 he entered Trinity College, Cambridge, but he remained there only three years, because he thought "the whole plan of education was radically wrong." He was next sent to France with the English ambassador, that he might learn "the arts of state."

His father's death for a time ended all hope of advancement at court. Cut off from the honors which he had hoped to gain, Bacon then turned his attention to law. He was admitted to the bar in 1582, and his success was immediate, for he was a convincing speaker and a sound lawyer. The poet Ben Jonson declared that "the fear of every man that heard him was lest he should make an end." Through the friendship of the Earl of Essex, Bacon won advancement at the court. In spite of writing that "There is no vice that doth so cover a man with shame as to be found false and perfidious," he later repaid the earl's kindness by helping to convict him of treason and to bring him to the block.

Bacon rose rapidly to the positions of attorney-general, privy councilor, and lord chancellor, in the latter position being head of the Court of Chancery as well as presiding officer of the House of Lords.

Students now recognize that he was one of the profoundest statesmen of that age, but the good advice which he gave King James I was usually disregarded.

In his published essays Lord Bacon gives this advice: "Seek not proud riches, but such as thou mayest get justly, use soberly, distribute cheerfully, and leave contentedly." But he himself was charged with receiving bribes in his court, and was impeached and convicted; he was sentenced to imprisonment and to pay an enormous fine, and was prohibited from afterwards holding a public office. Although Bacon proudly boasted that he had been "the justest chancellor that hath been" since his father's day, he confessed that his punishment "was just and for reformation's sake," because the old practices which he had carelessly followed were bad.

He was soon released from prison (after four days) and excused from paying the fine, but his exclusion from office continued in force. Cut off from his cherished career, he turned all of his attention to literary and scientific pursuits. He urged that in science men should reach their conclusions only by experimentation, and so is reckoned one of the founders of the modern "inductive" or scientific method of inquiry. His essays are full of shrewd, pithy, pungent observations, such as these: "He that hath wife and children hath given hostages to fortune"; and "Reading maketh a full man, conference a ready man, and writing an exact man." Bacon's life was finally sacrificed to his search for truth, for while testing whether snow would preserve meat he took a cold which proved fatal.

In the 19th century several writers sought to prove, on the strength of alleged "cipher" messages in Shakespeare's works, that Bacon wrote those immortal plays; but most students of literature were not convinced by the evidence.

Bacon's principal writings are: 'Essays' (1597); 'The Advancement of Learning' (1605); 'Novum Organum' (1620); 'History of the Reign of Henry VII' (1622); and the 'New Atlantis' (1626).

BACON, NATHANIEL (1642-1676). Thoughtful students of American history see in "Bacon's Rebellion" of 1676 the spirit of the Revolution of a century later.

The Virginia colony at that time was so misgoverned by Sir William Berkeley, the tyrannical governor appointed by the English king, that the colonists burned with discontent, and the Indians grew bold to attack outlying plantations. When no official measures were taken to stop the Indian outrages, Nathaniel Bacon, a young lawyer who had emigrated from London to become a planter, organized his neighbors and punished the guilty tribes. The obstinate and treacherous conduct of Governor Berkeley caused the movement to broaden into a struggle of the democratic element among the colonists against the old aristocratic clique who supported the governor. In the course of the struggle Bacon burned Jamestown to the ground, and drove the tyrannical governor to take refuge on an English ship.

Dying soon after, at the early age of 29, Bacon was never brought to trial. But Governor Berkeley executed a terrible vengeance upon Bacon's followers. King Charles II was emphatic in his disapproval of Berkeley, saying: "That old fool has put to death more people in that naked country than I did here for the murder of my father." The affair created a great stir in London, and secured more respectful attention to the needs and wishes of the American colonists.

BACON, ROGER (1214?-1294?). Three hundred and fifty years before Sir Francis Bacon revolutionized scientific method, the English friar, Roger Bacon, anticipated him in emphasizing the need of observation and experiment as the true basis of science.

After studying at the universities of Oxford and Paris, Roger Bacon became a Franciscan friar and taught at Oxford. He was far in advance of the scholars of his day, for he was able to read both Greek and Arabic books in their original tongues. He believed that knowledge could be more certainly and rapidly advanced by experimenting with real things than by poring over the books of Aristotle. He knew something of gunpowder and the magnetic needle, and gave directions for constructing a telescope. He believed that the earth was round and that it was possible to reach Asia by sailing westward into the Atlantic. In one of his numerous writings he suggested the possibility of these modern inventions:

"Ships will go without rowers and with only a single man to guide them. Carriages without horses will travel with incredible speed. Machines for flying can be made in which a man sits, and skilfully devised wings strike the air in the manner of a bird. Machines will raise infinitely great weights, and ingenious bridges will span rivers without supports."

Is it surprising that to the Middle Ages Bacon's knowledge seemed the result of magic? Again and again he was ordered by his superiors to cease from his writing and teaching. But in Pope Clement IV for a time he found a friend who commanded him to set forth his views in a book.

In spite of the jealousy of his brother friars and superiors, and the want of funds, instruments, writing materials, and copyists, Bacon now in 18 months produced three great books ('Opus Majus', 'Opus Minus', and 'Opus Tertium'), which he sent to the pope. After Clement's death, Bacon again fell into difficulties as a result of his attacks on the scholars and learning of his day; and by order of the head of the Franciscan order he was imprisoned for 14 years (1278-1292). His death followed not many months after his release.

Because he was so far in advance of his time, it is only in our own day that Roger Bacon's true greatness, as one of the world's most original thinkers, has been recognized.



At top of first circle are sour milk bacteria; below, cream and butter makers. In second circle, makers of alcohol.

THE world is filled with these tiny microscopic plants, which are at once the greatest friends and the greatest enemies of mankind—clearing the earth of its dead animals and plants, aiding man in many of his industries, but also afflicting him with the deadliest of his diseases.



In the first circle are the microbes that make vinegar; in the second, the microbes that make cheese.

The GOOD AND ILL that BACTERIA DO

BACTE'RIA. Nature is in a constant state of change. Life is produced and destroyed, and the chemicals in the world's workshop are continually combining into higher forms which make the bodies of plants and animals, and then breaking down again into the simple elements which form the air, the soil, and the rocks. The little creatures called bacteria are the chief laborers in this great workshop, performing many tasks which man with all his science and ingenuity is unable to imitate.

For every living creature we can see on this earth, there are billions—too small for us to distinguish—of these bacteria. If we could turn our eyes into microscopes and observe the daily lives of these tiny beings, we should be astounded, not only by their vast numbers, but by the tremendous work they do.

Under the name of "germs" we know certain bacteria as agents of disease (*see Germ Theory of Disease*). But by far the greater number are not only harmless but absolutely necessary to man's welfare. No other living things perform such valuable labor as these active bits of vegetable life—for bacteria belong to the vegetable rather than the animal world. It was not until the middle of the 19th century that their services, as well as their harmful effects, were recognized by scientists. Today the science of bacteriology is one of the newest and most important branches of our knowledge.

Bacteria which Act as Scavengers

Decay and decomposition in the bodies of plants and animals is caused by bacteria. When a wild creature dies in the woods, its carcass soon disappears, returning to the soil the materials of which it is composed; this "putrefaction" is the work of bacteria.

When a tree falls to the ground, it is compelled to yield up again the life-giving substances it can now no longer use; this rotting is the work of bacteria. Why is it that the great garbage dumps, still found near some cities, do not keep on increasing in size until they afflict the whole community with their unwholesome influence? Because vast armies of bacteria are

at work night and day cleaning up the refuse, reducing it to good soil and clean air again. Nothing can escape these scavengers, for they are in the air, in the ground, in the water—everywhere that life is found.

All processes of fermentation are due to bacteria or their cousins the *fungi*. Bacteria turn milk sour, and without their aid butter and cheese could not be made. They produce the alcohol in wines and cider, and then turn that alcohol into vinegar (*see Fermentation*). Few things can resist for long the combined efforts of the bacterial forces. It has recently been discovered that they even besiege huge rocks in the deserts and crumble the harsh stone into fertile soil.

Their most important work, indeed, is in the field of agriculture. Here they solve one of nature's greatest problems. All plants need nitrogen to build their living cells. The greatest source of nitrogen is

the air, but the pure nitrogen of the air is a stubborn and unsociable substance, which is unwilling to combine with other substances and to do its share of the world's work. Most plants are unable to seize and use this nitrogen in its ordinary state. But certain kinds of bacteria, called "nitrifying" bacteria, absorb it and produce the nitrogen compounds upon which other plants can feed (*see Nitrogen*).

But nitrogen is not the only substance that is

THE LITTLE NITRATE FACTORIES



This is an alfalfa root on which are groups of the kind of bacteria that manufacture nitrates and so supply the soil with this necessary plant food.

handled by bacteria for man's benefit. Carbon dioxide gas is extracted by them from the cellulose fiber of dead plants washed into the mud of marshes and pools. This gas is then returned to the atmosphere, where with the aid of sunlight the plants can again use it to produce carbon for themselves and oxygen for animals and men.

During this process the cellulose bacteria set free "marsh gas," which decomposes any substances containing sulphur. The sulphur is then seized by another set of bacteria and converted into sulphates again, in another spot, thus spreading these valuable chemicals over the earth. There are even bacteria which carry iron from place to place in the same way.

Certain bacteria have the power to absorb light and produce the phosphorescence found in many ocean creatures. Others produce heat by releasing oxygen. The heat found in the center of hay that has been stacked while moist is created by them. They are, indeed, held responsible for many cases of spontaneous combustion. Still other bacteria produce brilliant coloring matter.

Industries which are Based on the Tiny Plants

Hundreds of industries employ bacteria in profitable ways. We have mentioned cheese- and butter-making, but tanning also requires their aid. The farmer's silo would be useless without them. The preparation of tobacco, of indigo, of scores of commercial products, calls for their assistance. So if some evil members of the bacterial family create trouble and suffering by spreading disease, we must not forget that the others seem to be doing all in their power to make up for it.

To describe bacteria, men had to invent a new unit of measurement, called the *micron*. This is one-thousandth of a millimeter in length, and it takes about 25,000 microns to make an inch. Most bacteria are about one micron wide and from one to seven microns long. This means that one thousand bacteria can lie side by side on the head of a pin.

Bacteria are of many shapes, but they fall generally into one of three classes: *bacilli* or rod-shaped bacteria, *cocci* or round ones, and *spirilla* or spiral and curled ones. Many bacteria are provided with *cilia*, or hairlike projections, with which the speediest ones can travel about four inches in 15 minutes. They multiply very rapidly by splitting in two. Under good conditions a bacillus will reach maturity and split into two bacilli in 30 minutes; each of these will at once proceed to repeat this performance, so that within 24 hours billions of bacilli are produced from the original parent.

Some bacteria, instead of splitting into halves, change themselves into cells called "spores." These may develop at once into the full-grown bacteria; or, if conditions of moisture and temperature are not favorable, they may lie in the spore state for days or even years before springing into active life. In this condition they are capable of resisting great extremes of heat and cold. In fact, even full-grown bacteria have been known to live comfortably in water heated to 160° F., while others have recovered

after being frozen for days in liquid air, at a temperature of 418° below zero. Fortunately, few of the disease-producing bacteria are so robust and vigorous. The article on Antiseptics describes the means used for killing these germs.

BADEN (*bä'den*), GERMANY. Just across the Rhine River from the French province of Alsace lies the republic of Baden, which was a grand duchy of the German Empire until 1918. It is the fourth in size of the German states, having an area of 5,800 square miles, a little less than that of Connecticut and Rhode Island combined. Its population of 2,000,000 slightly exceeds that of those two states. The greater part of its surface is mountainous, and about two-fifths is heavily wooded, falling within the region called the Black Forest (see Black Forest).

The chief manufactures are toys, textiles, cigars, chemicals, machinery, pottery, and jewelry. Pforzheim is especially famous for the latter. The most important agricultural products are wheat, oats, barley, rye, potatoes, sugar beets, hops, and the grapes from which both red and white wine are made. Karlsruhe is the capital, and Heidelberg is the seat of the oldest university in Germany. Mannheim, the largest city, is the chief manufacturing center and has a large river traffic. The mineral springs of Baden-Baden make it a famous health and pleasure resort.

In the Middle Ages, Baden was merely a group of feudal possessions, which continued to grow, little by little. The greatest additions were made during the Napoleonic era, when by fighting first on one side and then on the other the ruler won numerous concessions and was allowed to take the title Grand Duke. As a state of the German Empire, Baden had 14 members in the Reichstag or federal parliament, and three members in the Bundesrat or federal council.

BADGER. In traveling over the sagebrush plains of eastern California, Utah, and Oregon, you will be sure to see many a badger burrow. But unless you are lucky you may never catch sight of the badger

itself, for it is a timid animal and rarely comes out except at night. Even if you should surprise one away from its burrow, you might never notice it because of the extraordinary broadness and flatness of its clumsy body. When alarmed it will often flatten against the ground "like a doormat or a turtle"; and the long silky gray hairs, parted along

the spine, spread out in the grass on each side so that the animal might be mistaken for a clod of earth or a stone.

But beware of the badger when it is cornered, for it will fight like "a stack of wildcats." A single badger is often a match for several dogs, and hence the cruel sport of "badger-baiting" was once common in England and the west of the United States. From this practice we get the word *badgering*, meaning

BEWARE OF THIS FELLOW!



From this picture, showing Mr. Badger's broad flat body, you can form some idea of how he looks when he plays "doormat," and how hard it would be to find him in tall grass.

"persistent annoying." The jaws are so hinged that dislocation is practically impossible, and hence they maintain their hold with great tenacity.

Badgers are common in the northern parts of Europe, Asia, and America. The head is pointed at the snout and the feet are armed with long claws used in digging

and for defense. The thick fur is valuable, and the hairs are used in the manufacture of artists' brushes.

The American badger belongs to the West and shows a fondness for the open prairie, Wisconsin being known specifically as "the Badger State." It is about two feet long and grayish in color with irregular black bands on the back; underneath the fur is whitish. The throat and sides of the face are white, with a white stripe running from the nose over the forehead, and in front of each eye is a black patch, a marking which gives the face a clownlike appearance. The legs and feet are black. With its strong claws the badger lays open the burrows of the prairie dogs, ground squirrels, gophers, field mice, etc., feeding upon these animals and on birds, frogs, small snakes, lizards, grasshoppers, and other insects.

Badgers belong to the weasel family (*Mustelidae*), which also includes skunks, otters, minks, martens, and wolverenes. Scientific name of American badger, *Taxidea taxus*; European badger, *Meles taxus*.

BAGDAD', MESOPOTAMIA. "The Glorious City" is the official designation on all Turkish documents of this city on the Tigris River, about 350 miles north of the head of the Persian Gulf. As one approaches Bagdad from the desert it appears truly beautiful. A mass of verdant palm trees rises out of the treeless plain, and glittering above these are the wonderful gold domes of the mosque tombs.

But this is a case where distance lends enchantment; as one comes nearer the city, the glories vanish. The houses of the town are crude constructions of brick, mostly from ancient ruins, and of adobe. The streets are so narrow at times that one beast of burden fills the entire space from wall to wall, and the Tigris River serves both as sewer and as the source of the water supply for the inhabitants.

How many people live in Bagdad no one knows, and estimates vary from 70,000 to 200,000. Of this population about one-fourth are Jews, descendants of those who were carried away into the Babylonian captivity by Nebuchadnezzar; one-tenth are Christians, and the rest are Mohammedans.

Straddling the Tigris at the point where that river and the Euphrates most nearly approach, the city has long commanded a large part of the traffic between India, Persia, and Europe.

The chief exports to Europe are wool, dates, wheat, horses, and oriental fabrics, while the imports are iron and copper, sugar and coffee. To control this trade, and to pave the way for political aggressions, Germany in 1902 obtained from the Turkish government the right to build a railway to Bagdad. She immediately began her famous Berlin-to-Bagdad railroad, which was completed to a point about 400 miles north of Bagdad when the World War of 1914-18 broke out. With the occupation of Bagdad by the



THE BAGDAD OF THE 'ARABIAN NIGHTS'

For any subject not found in its alphabetical place see information

British on March 11, 1917, the dream of German domination of the East ended. With the British capture of the city also ended the Turkish dominion, under which the country had suffered for centuries, and under which the glories of Bagdad had largely departed.

The city was built in 762 A.D. as the capital of the Moham-medan world. That was the time of its glory, for Bagdad with its population of 2,000,000 was then the largest city in the world. Under the rule of the Arabs it was preëminent in literature, in art, and in science. Those were the days of the 'Arabian Nights' and of the splendid court of Harun-al-Raschid, the calif who was contemporary with Charlemagne. The Paris and London of that day were but miserable villages compared with Bagdad, "the capital of the world, the center of luxury, the emporium of commerce, and the seat of learning." The calif's treasury was heaped with gold; the calif's court was thronged with learned men, poets, jurists, grammarians, wits, scribes, and musicians; and among them all who so wise and pious as the great Harun himself, scholar and poet, who prostrated himself a hundred times daily and made the pilgrimage to Mecca many times? But ruder Asiatics envied the wealth of Bagdad, and in time the Turkish guards plundered it. Then it was sacked by the Mongols in 1258, and its glories departed. After being plundered and robbed again and again by Mongols and Tatars, it finally became a part of the Turkish Empire in 1638.

BAGPIPE. In the highlands of Scotland, in Brit-tany, and in parts of Italy the bagpipe is the most popular of musical instruments. Once it was common in nearly all parts of Europe. As usually made it is a large leather bag, often covered with cloth, having a mouth-tube by which the player fills the bag with his breath. The tune is played on a pipe with finger-holes, and three other pipes called "drones" each continuously sound a single note of the scale. Sometimes a bellows is used to blow up the bag.

The bagpipe is a very ancient instrument. It is spoken of in the Old Testament, and was used by the Egyptians, Greeks, and Romans. It is the national instrument of the Scottish Highlanders, and pipers are attached to Highland regiments in the British army.

BAHAMAS (*bā-hā'mās*). Columbus made this group of islands in the West Indies famous, for Watling Island, the outermost of the Bahamas, called by him San Salvador, was probably the first land sighted in the New World.

The Bahamas form a line 600 miles long from a point off the east coast of Florida to the island of Haiti. Through this barrier there are but three chan-nels for large vessels, for the islands are merely the exposed tips of a great submarine range composed of coral, shell deposits, and sand. In all the 20 inhabited islands there is only one running stream, which is found on Andros. Fresh water is supplied by wells dug in the soft rock. This rock formation grows hard on exposure to air and thus provides ideal building material.

The Bahamas, populated chiefly by negroes, belong to Great Britain. The climate is agreeable and healthful, and Nassau, the capital, situated on New Providence Island, is a popular winter resort. Fruits and vegetables grow in profusion. The chief exports are sponges, sisal hemp, salt, tomatoes, and canned

pineapples. The total area of the 3,077 islands and islets is about 4,400 square miles. Population, about 60,000.

BAIKAL (*bī'kāl*), LAKE. A large and very deep body of fresh water in southern Siberia, 386 miles long and 20 to 50 miles wide. It is fed by numerous streams from the Baikal Mountains, a spur of the Altai Range, and the chief outlet is the Angara River, a confluent of the Yenisei. Trains of the Trans-Siberian Railroad were formerly ferried across Lake Baikal, but now pass around its southern end. The lake is crescent-shaped and is believed to be the deepest fresh-water lake in the world, having a maximum depth of more than 5,600 feet. It abounds in fish, including salmon, sturgeon, and fresh-water seals. Steamboats have begun to develop trade on the shores of the lake, which are rich in petroleum. For four or five months of the year its waters are frozen and trade is carried on over the ice.

BAKING POWDER. Similar to the action of yeast in making bread is that of certain chemically prepared substances called baking powders, in making biscuits, cake, and other quickly-made "breads." Like yeast, they generate the gas carbon dioxide, which forms bubbles and thus "leavens" the dough or causes it to rise and become light and porous. Baking powders take less time to act than yeast, since they form carbon dioxide by direct chemical action, while yeast forms it by fermentation.

Baking soda (bicarbonate of soda) is the active agent in most baking powders; but they are usually classed as belonging to one or another of three groups according to various supplementary substances which they contain. Thus we have cream of tartar pow-ders, which contain potassium bitartrate; phosphate powders, in which a phosphate such as potassium orthophosphate is one of the ingredients; and alum powders, containing some form of alum. The possible harmfulness of alum baking powders is a disputed point (*see* Alum). A little starch is added to keep the other ingredients apart and prevent interaction before use.

Much the same result is obtained by using baking soda with sour milk. Used alone, baking soda will give off carbon dioxide, but the sodium carbonate it leaves behind has a disagreeable taste and gives the food an unpleasant smell; the other constituents of baking powders are added to prevent this.

BALBO'A, VASCO NUNEZ DE (1475-1517). On Sept. 25, 1513, the Spanish explorer Balboa beheld from the top of a mountain in Panama the gleaming waters of the western ocean—

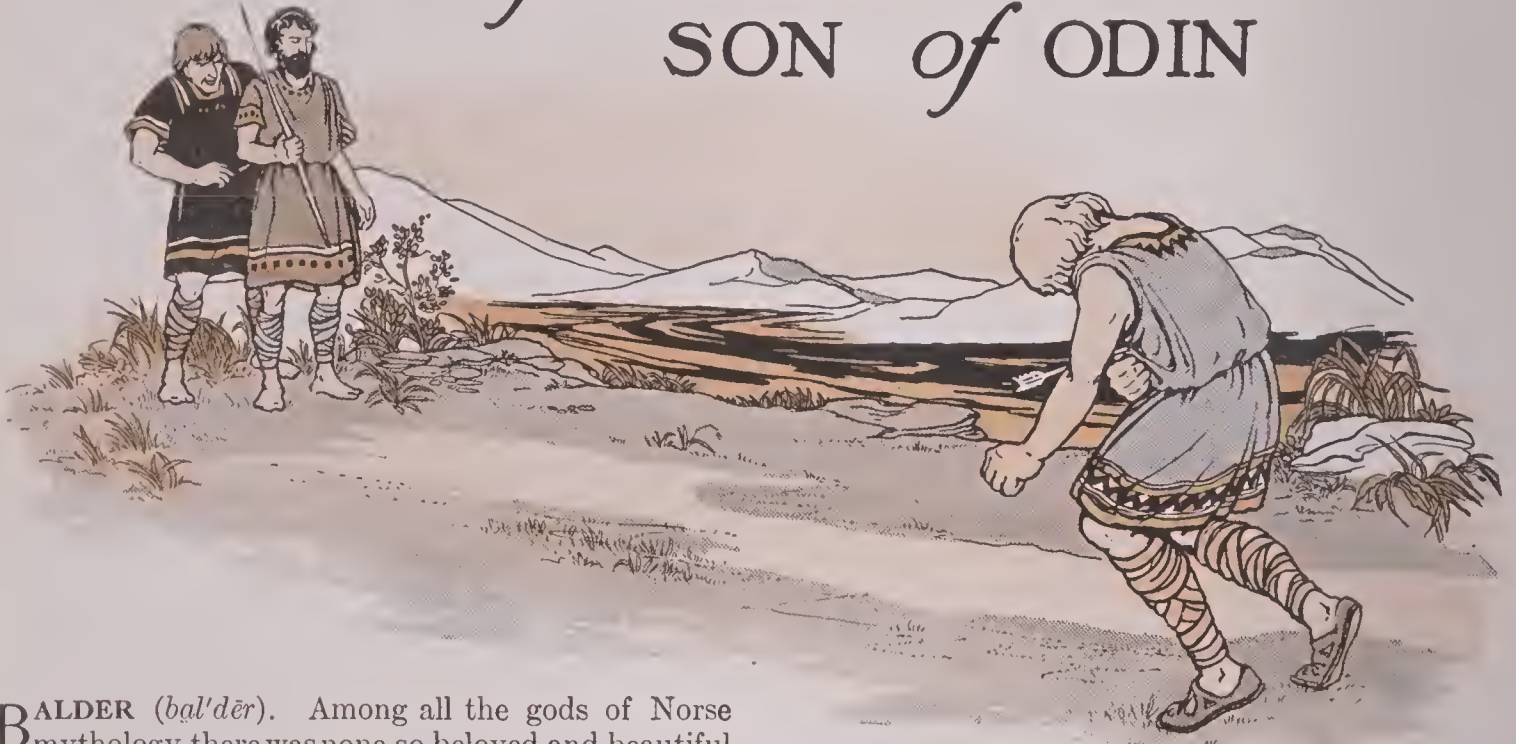
. when with eagle eyes,
He stared at the Pacific—and all his men
Looked at each other with a wild surmise—
Silent, upon a peak in Darien.

He was the first European to look upon the waters of that mighty ocean, and to him also belongs the honor of being the first white man to cross the Isthmus of Panama.

Balboa was a Spanish adventurer who had unsuccessfully tried farming in San Domingo. When he left that settlement in 1510 to join an expedition to Darien, he had himself taken on board ship in a cask labeled "victuals for the voyage," in order to avoid his creditors. When he gained control of the colony of Darien he started on his explorations in order to keep the favor of the Spanish king; and for him he

claimed the "South Sea," as he called the Pacific, and all lands washed by it. He was too late, however, with his peace offering, for when he returned to Darien he found that a new governor had been appointed in his place. Friction between the two developed immediately, and as the governor had the power in his hands, he threw Balboa into prison. Later he had him beheaded for stirring up a rebellion.

STORY of BALDER, SON of ODIN



BALDER (*bal'dēr*). Among all the gods of Norse mythology there was none so beloved and beautiful as Balder, son of Odin. When he passed it was like the coming of sunshine, and every grief fled before the brightness of his presence. In all his life he had never known a moment of sadness, and the gods vied with one another in showering favors upon him.

One night his sleep was haunted with dreams of dire disaster. When the gods learned of this, sorrow fell upon them. His mother Frigga heartbroken roamed the earth, supplicating all living things not to harm her son, and they willingly gave their promise. The gods thereupon rejoiced and happiness reigned in Asgard, their habitation.

Thenceforth Balder led a charmed life, and on festival days the gods hurled missiles in play at the invulnerable hero, who smiled when darts and stones fell harmless at his feet.

But among the gods was one selfish, jealous being named Loki, who wished to put an end to Balder's reign of love. Disguising himself, he sought out Frigga and obtained from her the admission that there was one frail little plant, the mistletoe, whose promise of protection to Balder she had neglected to get. It was so insignificant and inaccessible in the oaks of the mountain-side that tired with her journey she had failed to visit it.

On the strength of this information Loki made a spear shaft out of the oldest, toughest sprigs of

mistletoe. Hoder, a blind god, loving Balder and wishing to honor him, consented to throw the shaft, not knowing that it alone of all things was harmful to the beautiful god. Pierced to the heart, Balder fell, and his spirit journeyed to the underworld. Sorrowing, the gods pleaded for the release of Balder. The ruler of the underworld consented, provided that every living thing should weep for his return. The whole grief-stricken world immediately began to weep, with the exception of the hateful Loki. Balder therefore was not released, and he has dwelt in the underworld from that day to this.

A tiny, aster-like flower with pure white petals, which grows everywhere by the roadside, is called in his honor, "Balder's brow." In the Norseland when the dark long winter sets in the people say, "All nature sorrows for Balder." And when the spring breaks forth with budding trees they cry, "The spirit of Balder again roams the earth."

BALDWIN, ROBERT (1804-1858). That Canada is today a loyal and contented member of the British Empire is due in large measure to the far-seeing political wisdom of Robert Baldwin. During the early half of the 19th century, when Canada was in the grip of a Tory oligarchy that distributed offices and lands as it pleased and ruled without regard to the desires of the people, Baldwin came to the front as leader of the moderate wing of the group of statesmen known as the Reformers. Their task was to lay

the foundations for Canadian self-government, to reconcile democracy and empire, and thus save Canada from breaking the bond that joined it to the mother country.

Elected to the legislature of Upper Canada in 1829, four years after he began the practice of law in the town of York (now Toronto), Baldwin at once became the champion of responsible government. He held that the only cure for the manifold evils of the day was to establish the English system of cabinet and parliamentary government, with a legislature elected entirely by popular vote. He so constantly advocated this reform that he came to be known as "the man with one idea." But though he was indefatigable in his efforts to bring about responsible government, he had no sympathy with the extremists who, goaded by the stubborn opposition of the Canadian Tories and the British Colonial Office, launched the ill-fated rebellion of 1837-38. (See Mackenzie, William L.; Papineau, Louis J.)

Twice Baldwin was called to the executive council, in 1836 and 1841, only to resign on questions involving the principle for which he was fighting. But at last, in 1842, after the union of Upper and Lower Canada, he won his first great triumph. With Louis Hippolyte LaFontaine, the Liberal leader of Lower Canada, he formed the first administration to accept responsible government. But a controversy with the governor-general soon led to his resignation. In 1848 Baldwin and LaFontaine were again returned to power, and the principle for which they had fought so courageously was finally established. Although the Baldwin-LaFontaine ministry carried through an unprecedented number of important reforms, it was not radical enough for the extreme wing of the Liberal party, and Baldwin resigned in 1851. The remainder of his life was devoted to bringing about a better understanding between the English and French sections of Canada.

BALEARIC (*bäl-e-är'ic*) **ISLES.** This group of islands lies off the Mediterranean coast of Spain. The five largest are Majorca (or Mallorca), Minorca, Iviza, Formentera, and Cabrera. They were an independent kingdom in the 13th century, but now form a Spanish province. Vines, olives, and fruit trees are abundant. Port Mahon, in Minorca, is one of the finest harbors in Europe.

The Phoenicians and Greeks visited the islands in early times. Later they were subject to Carthage, but were added to the Roman Empire in 123 B.C. The natives were famous slingers in the Carthaginian and Roman armies, and their name, *Baleares*, comes from the Greek word *ballein*, meaning "to throw." The area is 1,935 square miles; population, about 330,000.

BALKAN (*bäl-kän'*) **PENINSULA.** The "wild west" of North America, where once savage Indians ranged the plains and cowboys and bandits made life picturesque but uncertain, has vanished. But in southeastern Europe, in the region known as the Balkan Peninsula, there still persists an age-long wild-

ness of land and costume, which makes it a land of romance and fascinating interest, at the same time that it is for statesmen the "firebrand of Europe."

The Balkan Peninsula is the easternmost of the three southern peninsulas of Europe. Its northern limit is fixed by the Danube and Save rivers and the Transylvanian Alps. On the east, at the Dardanelles and the Bosphorus, it approaches so closely to Asia that it forms a bridge between the two continents. On the west it looks across the Adriatic to Italy, whose interests and ambitions now parallel, now oppose, those of the Balkan peoples.

For the most part the country is a wild mountainous region, underlaid by rich mineral deposits which, owing to the backwardness of the country, are still almost untouched. Running westward from the Black Sea are the lofty and rugged Balkan Mountains, from which the peninsula takes its name. These soon split up into other ranges, one of which—the Pindus Mountains—extends to the southernmost tip of Greece. The peaks range from 3,000 to 10,000 feet in height. North of the Danube River lie the plains of Rumania, which geographically are an extension of the plains of Russia rather than part of the Balkan Peninsula, but politically Rumania is grouped with its neighbor states to the south. In this plain large crops of wheat can be raised, but in the rest of the Balkans it is only a precarious existence which the inhabitants wrest from the soil by means of a primitive agriculture.

A Medley of Races and Tongues

A part of the unprogressiveness of the people of the Balkans is due to the mountainous character of the country itself, but more must be charged to its history. Although the peninsula, including Rumania, has an area of only about 200,000 square miles—little more than two-thirds the size of Texas—it contains more different peoples, with separate languages, customs, national aspirations, and religions, than any other equal area in the world.

At the opening of the World War, in 1914, the Balkan Peninsula was divided among eight different countries—Serbia, Montenegro, Albania, Greece, Bulgaria, Rumania, Turkey, and Austria, for the latter country held the westernmost districts called Bosnia, Herzegovina, and Dalmatia. The peoples were even more numerous than the countries. The Albanians are believed to be descended from the ancient Illyrians, who probably came into the peninsula about 3,000 years before the birth of Christ. The Greeks trace their history back to the days when Greece was the center of the world. The Rumanians recall in their name (from "Rome") the days when their ancestors were sent out by the Roman emperor to guard the boundaries of his empire. The most numerous race are the Slavs, but there are several different branches of this stock—Bulgarians, Serbs, Croats, and Slovenes—and there is much admixture of other stocks, Turkish, Armenian, and the like. Around Constantinople the Turks predominate.

THE MOUNTAINS WHERE THE WAR CLOUDS GATHER



Mountains which cut up a land into small sections cause the formation of "war clouds"—in the Balkans, at least—as naturally as mountain peaks gather clouds that bring the rains. The Balkan Peninsula has been the scene of constant wars ever since the days of the Greeks.

If each of these peoples were settled in one definite area, the Balkan question might admit of solution, but practically every one of these groups is scattered over the greater part of the peninsula. Rumanians are found in Bulgaria, Greeks in Turkey, and Slavs everywhere. In addition to this intermingling of peoples there is an equally troublesome interming-

ling of religions—Greek Catholic, Roman Catholic, Armenian Catholic, Mohammedan, Jew, etc.—which still further complicates the "Eastern Question," as the problem of the Balkans is usually called.

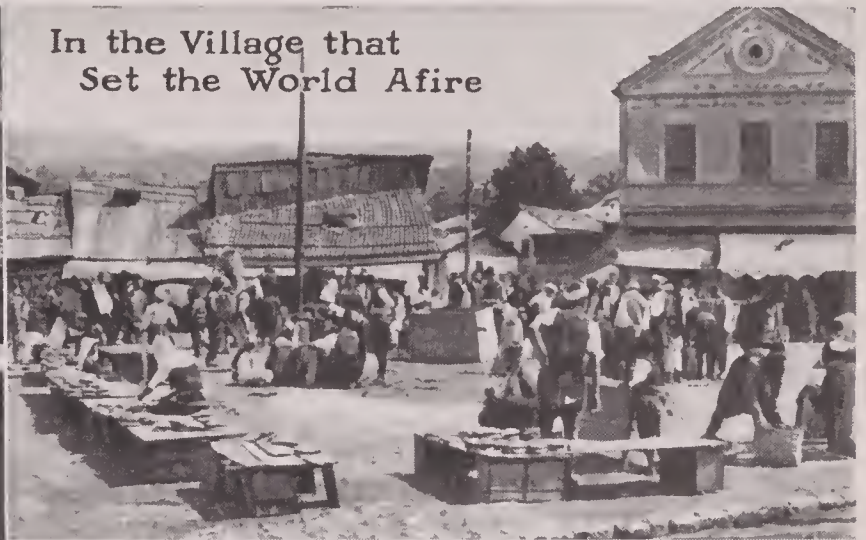
At rare intervals the whole Balkan Peninsula has been united under one government. For example, it all formed part of the Roman Empire in the days of

For any subject not found in its alphabetical place see information

FAMILIAR SCENES IN THE BALKAN LANDS



A Hooded Woman of Mostar

In the Village that
Set the World AfireA Slovak
Freight Car

The Women in the Fields

Men's Fashions
in the Balkans

No one who tours the Balkan countries will fail to remember the market place in Serajevo (Bosnia), the town in which the Austrian crown prince was assassinated, thus bringing on the World War; nor the women reaping in the fields; nor the quaint costumes of the peasants in some districts. Where the Mohammedan faith prevails the women never appear in public without their long robes that shroud them from head to foot and with heavy veils over their faces.

the supremacy of the City of the Seven Hills. But when the barbarian invasions began, in the 4th century, the Balkan Peninsula was the first part of the empire invaded. Successive waves of Visigoths, Ostrogoths, and other peoples came into the country, but were pushed on farther west by the hordes of Slavs pressing upon them from the north. Then came the Turkish invasion. In 1453 Constantinople fell, and the Turkish power was soon established up to and beyond the Danube.

In the 19th century came the gradual redemption from Turkish rule. In spite of frequent uprisings, it was not until 1830 that Greece managed, with the aid of the western European nations, to gain her independence. One by one the other Balkan nations freed themselves from Turkish oppression, until now Turkey holds in Europe only the city of Constantinople.

A number of Balkan wars accompanied this break-up of the Turkish Empire. In 1828-29 Russia aided

the Greeks to win their independence. Twenty-five years later the Russian demand for a protectorate over all Christians of Greek faith residing in Turkey precipitated the Crimean War (1854-56) in which Great Britain, France, and Piedmont came to the aid of Turkey and defeated Russia. The troops of the Czar intervened a third time, in 1877-78, to aid the revolting Serbians and Bulgarians against the Turkish policy of massacre; but the Peace of San Stefano, which Russia forced upon Turkey, was set aside by the other powers in the Congress of Berlin in favor of one much less favorable to the oppressed Christian peoples.

Russia's interest in the Balkans was traceable chiefly to her desire to obtain possession of Constantinople and other parts of the inheritance to be left by the "sick man of Europe," as the Czar once called the decaying power of Turkey. For over a century the game of intrigue and war over the "New East" went on, the other powers of Europe interfering at times to aid the subject peoples in their revolts, and at times to block Russia's plans. Then Austria began to dream ambitious dreams of eastward extension—the *Drang nach Osten*—and these gradually linked up with Germany's far-reaching plan for a Berlin-to-Bagdad railway and a "Middle-Europe" under Teutonic control, in which the Balkans should be their "corridor" into Asia.

Many calculations were upset when, in 1908, the "Young Turks" seized the government of Turkey, and sought to restore the "sick man's" waning vitality. Austria made

haste to annex Bosnia and Herzegovina—two Turkish provinces which she had administered for some time—and Bulgaria declared her complete independence.

The Young Turks proved themselves, if anything, more oppressive to the Christian populations than the old government had been. After a massacre of Christians in Macedonia in 1912, Serbia, Greece, Bulgaria, and Montenegro formed the Balkan League against Turkey. When that country was weakened by war with Italy over Tripoli, they declared war on it in October 1912. By striking in different places at the same time they completely overwhelmed Turkey, which in six months' time was forced to ask for peace. The Treaty of London, signed on May 30, 1913, limited her territories in Europe to a small strip about Constantinople.

Because of the interference of other countries, however, the peace was short-lived. Austria and Italy had insisted on the creation of Albania as a separate principality in the western part of the Balkans. This upset an agreement which had been made by Greece, Serbia, and Bulgaria for the division of the conquests from Turkey, and in June they commenced fighting among themselves. Rumania joined the other Balkan nations in opposing the claims of Bulgaria, and that country was defeated. By the Treaty of Bucharest (signed in August 1913), Serbia and Greece gained increased territory, but Adrianople was handed back to Turkey.

These Balkan wars were the prelude to the World War of 1914-18. Germany and Austria had supported Turkey against the Balkan allies in 1912, and Bulgaria against the other allies in 1913. The double defeat was a serious blow to German and Austrian prestige, so both were glad, in July 1914, to seize upon the murder of the Austrian archduke at Serajevo as a pretext for crushing Serbia. This precipitated the greatest war the world has ever seen and one which incidentally had far-reaching effects on the peoples and states of the Balkan peninsula. Serbia, Rumania, and Greece were all enlarged, while Bulgaria was reduced in area. (See World War of 1914-18; also articles on the separate states.)

FLYING GAS-BAGS *from* MONTGOLFIER *to* ZEPPELIN

*The Story of How Man Learned to Soar Higher than the Highest Mountains
and Float at Will Through the Invisible Ocean of Air*

BALLOON. On June 5, 1783, a large crowd was assembled in a field near Annonay, France, in the center of which stood a pile of straw and a mass of linen cloth supported on a frame. Presently fire was set to the straw and slowly the cloth swelled into the form of a huge bag, as the hot air and smoke ascended into it. When fully inflated it was let go. The bag rose rapidly to a great height, remained in the air ten minutes, and descended a mile and a half away. The credit for this first balloon ascent in history—though without a passenger—belongs to two brothers named Montgolfier, the sons of a wealthy paper manufacturer.

For 4,000 years men had known how to weave cloth, and ever since fire was discovered they had known that smoke ascends. They had the materials for balloons; all they needed was the idea. Joseph Montgolfier was the first man in history to conceive the idea of "harnessing smoke" by confining it in a bag.



On Aug. 26 of the same year, J. A. C. Charles, a noted French scientist, sent up from Paris a bag of varnished silk, 13 feet in diameter, filled with hydrogen gas. It rose 3,000 feet and traveled 15 miles into the country. There the terrified peasants, believing it to be an evil spirit, fell upon it with pitchforks and tore it to pieces. This was the first gas balloon.

The first living passengers in a balloon went up on Sept. 19, 1783, at Versailles, in a Montgolfier model. They rose to 1,500 feet and descended eight minutes later in a forest two miles away. The passengers were none the worse for the trip, except that one of them had kicked another severely. The cause of the quarrel was never explained, for these first of all aeronauts were a sheep, a rooster and a duck!

The first human being who tempted fate in the clouds was Jean Pilâtre de Rozier, a native of Metz, Lorraine. He went up in a hot-air balloon on Oct.

IF THE PIONEERS OF FLIGHT COULD RETURN TODAY



These six Frenchmen, the fathers of aviation, amazed the world between 1783 and 1785 by demonstrating the possibilities of human flight. At the right are the brothers Montgolfier, who invented the hot air balloon (1783). Next come Professor Charles, who made the first hydrogen balloon the same year; Pilâtre de Rozier, the first human being to ascend in a balloon (Oct. 15, 1783); Jean Pierre Blanchard, who crossed the Channel from Dover to Calais (Jan. 7, 1785); and, in the foreground, the Marquis d'Arlandes, who accompanied De Rozier in the first flight in a free balloon (Nov. 21, 1783).

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15, 1783, near Paris. The balloon was "captive," being fastened to the ground by a long cable. Five weeks later, on November 21, De Rozier and the Marquis d'Arlandes soared from the ground without a cable, the first men to navigate the air in freedom. They remained up 25 minutes, drifting about five miles with the wind.

From that time on balloon ascents became increasingly common. Inventors learned how to hang small furnaces below the mouths of fire balloons, so as to keep up the supply of hot air and make longer trips possible. But the greatest development came in the gas balloon, which soon replaced entirely its elder brother.

Long before any successful experiments were made with balloons, men had discussed the problem of flying. Some believed it possible to hold themselves up with wings like a bird (*see* Airplane), but the majority of scientists thought the answer could only be found in "lighter-than-air" machines. The difficulty lay in finding a substance suitable for inflating balloons. The success of the Montgolfier experiment was really an accident, for the two brothers believed it was smoke that made their linen bag rise. It was not until later that hot air was recognized as the true source of their power. Air expands when heated, so that a cubic foot of hot air is lighter than a cubic foot of cold air. The difference in weight between the hot air inside the old fire balloon and the same amount of cold air was great enough to offset the weight of the balloon and passengers. The difficulty lay in keeping the air hot. When the fuel for the furnace was exhausted, there was nothing to do but come down.

What was needed was a gas which should be lighter than air, no matter what its temperature. Hydrogen possesses this quality to the highest degree, being 14 times lighter than air (*see* Hydrogen). Although some balloonists used the cheaper coal gas, it was not long before hydrogen became the standard.

The fire balloon could be made to rise and fall by regulating the heat of the furnace. For the gas balloon, however, it was necessary to devise a valve which would release a part of the gas when the aeronauts wished to descend. To enable the balloon to rise to higher levels, bags of fine sand were carried as ballast and emptied over the sides as needed.

Scientific Use of the Balloon

As soon as the balloon was sufficiently improved, science seized upon it as a means of exploring the upper reaches of the atmosphere, to ascertain the

variations of temperature and air pressure. It was in this manner that Prof. A. Berson and Dr. R. J. Süring, of Berlin, Germany, rose on June 30, 1901, to a height of 35,440 feet. At high levels balloonists

find the atmosphere so rarefied that it is hard to breathe, while the corresponding decrease in air pressure causes dangerous derangements of blood circulation. Indeed, many sky-explorers have died in their balloons, and these two German balloonists, even though they were equipped with oxygen tanks for breathing, were unconscious during a part of their trip.

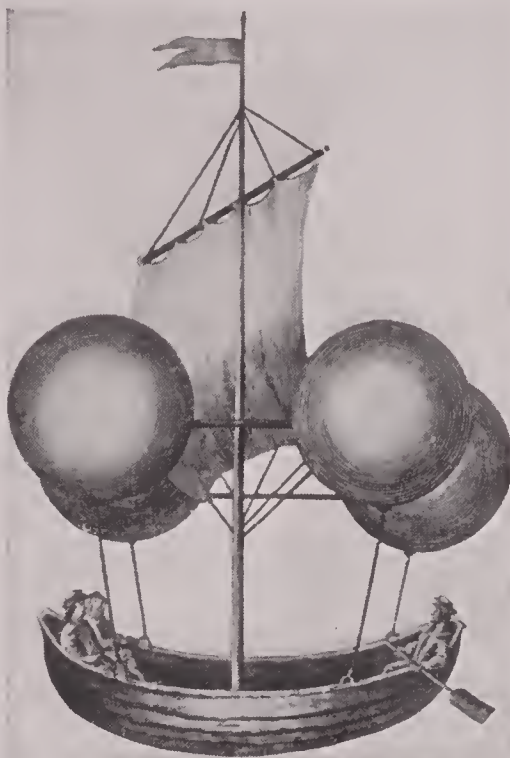
To obtain scientific information without these great risks, investigators hit upon the scheme of sending up self-recording apparatus, such as thermometers, barometers, etc., in small balloons which carried no passengers. One of these "sounding balloons" reached a height of 125,505 feet (23.38 miles), and brought back the information that at this tremendous height the temperature was 60 degrees below zero and the pressure only 1/250th of what it is at sea level.

The difficulty in reaching these great altitudes is not so much due to the inability of the balloon to float in the highly rarefied atmosphere, as to the fact that when the exterior pressure is so much reduced the gas bag tends to expand and burst. This obstacle has been overcome by sending up sounding balloons of india-rubber with a parachute attached which will bring the instruments back to earth safely after the balloon itself has reached its maximum height and exploded.

The round balloon, which is at the mercy of the wind the instant it leaves the ground, does not offer a satisfactory means of travel. Great distances, however, have been covered in such balloons. One of the longest trips ever made was by E. Rumpelmayer (March 19 to 21, 1913), who sailed 1,492 miles from Paris to a point near Kharkof, Russia. Explorers of unknown lands expected much aid from balloons, but their hopes were dashed by the tragic fate of Salomon A. Andrée, a Swedish scientist who set out July 11, 1897, from Spitzbergen, hoping to reach the North Pole, 600 miles away. A carrier-pigeon set free by him returned three days later, and two floating buoys were found with messages of his progress; but nothing further was ever heard of him or of his two companions.

During the Civil War in America captive balloons were used to some extent by the Union armies for observation, and during the siege of Paris, in the

A BOAT TO SAIL THE SKIES



This is the idea of a lighter-than-air machine set forth by Francis Lana, a Jesuit, in 1670. His project was to get lifting-power by exhausting the air from very thin copper globes.

Franco-Prussian War of 1870-71, many messengers were sent out of the imprisoned city by balloons. The chief difficulty was the lack of means for controlling the direction of flight, and modern science set itself to the task of solving this problem.

Balloons that Can Be Steered

The first effort to propel and steer a balloon by artificial means seems laughable to us today. The balloonists took up huge oars of cloth-covered framework and tried to row the big gas bag as you would row a boat on a lake! In 1852, however, Henri Giffard installed a light steam engine in the car of a cigar-shaped balloon, and achieved near Paris the first feeble flight against the wind. But it was not until the beginning of the 20th century that any notable success was recorded in such attempts.

On Oct. 19, 1901, Alberto Santos-Dumont steered a cigar-shaped dirigible balloon, 108 feet long, 20 feet in diameter, and equipped with a propeller driven by a gasoline engine, around the Eiffel Tower in Paris, at the rate of 19 miles an hour. This feat proved to the world the future usefulness of the "airship." Germany, which organized for war as did no other country, at once saw the military possibilities of this invention, and from this time forward the supremacy in air navigation passed from France to Germany, chiefly

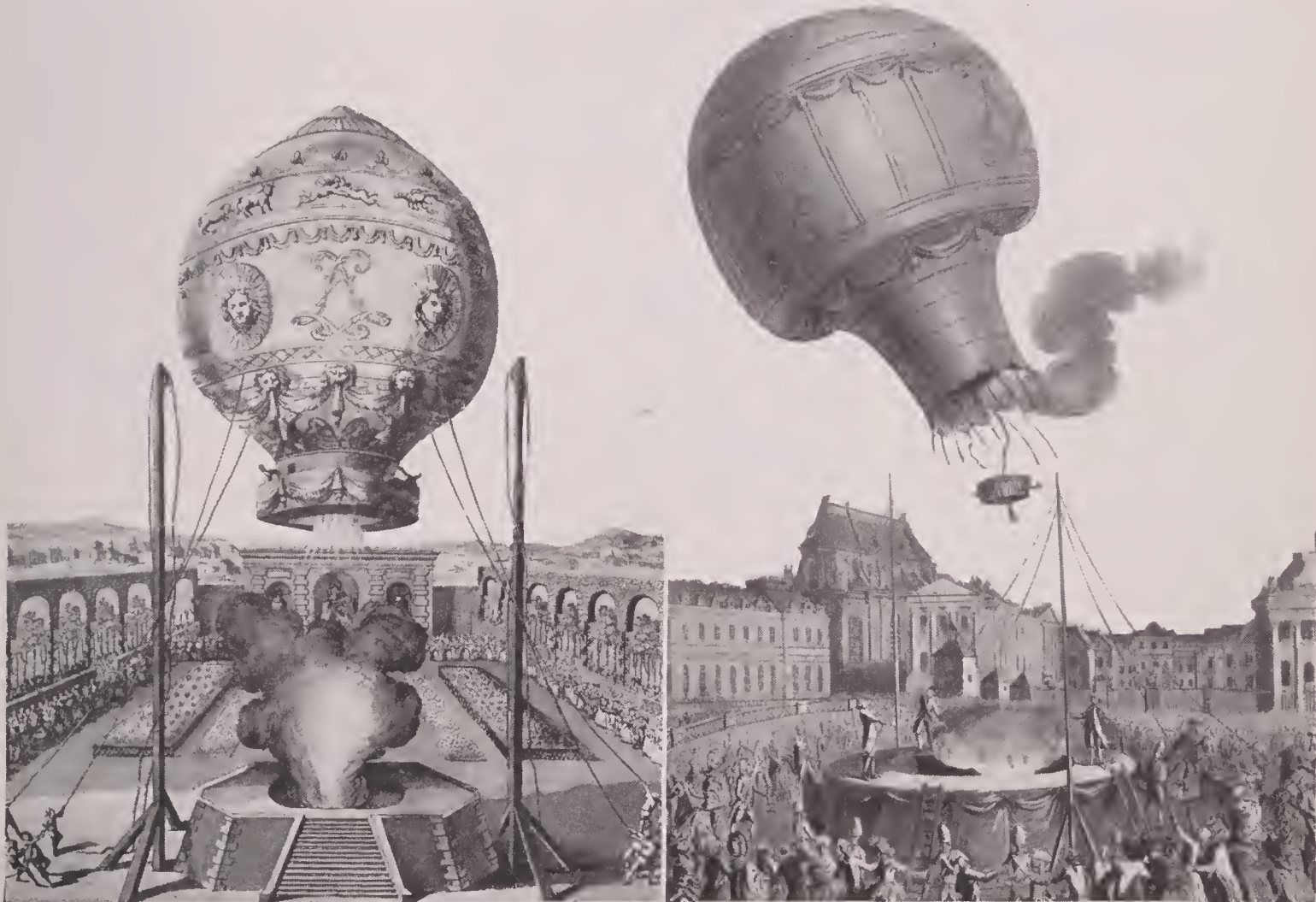
through the efforts of Count Ferdinand von Zeppelin.

It is said that during the American Civil War, Count Zeppelin, then a young military attaché to the German embassy in Washington, obtained the privilege of going up in one of the observation balloons behind the Union Lines. What he saw convinced him of the military value of balloons, and he returned to Germany to devote his life to this work. From 1897 on, his long experience was brought to bear on building dirigibles, but of a different type from those used by Santos-Dumont.

Count Zeppelin found that the long gas bag, which was necessary to give speed and steadiness, had a tendency to "buckle" in the middle when driven against the wind, so he constructed a rigid framework of aluminum, with compartments to hold many separate drum-shaped gas bags, tapering in size toward each end. The whole structure was covered with varnished silk. The framework also enabled him to attach some of the propellers to the balloon itself, instead of to the car, as had been done by other inventors. It also made it possible to bring the cars closer under the balloon, all of which gave increased power and lessened the "drag" of the air.

The first test of a "Zeppelin," as these huge rigid airships came to be called, was made in June 1900,

THE FIRST BALLOON ASCENSIONS IN THE HISTORY OF THE WORLD



These pictures, from old prints, illustrate two of the experiments of the Montgolfier brothers with their balloons. That on the left took place in the gardens of their father, a rich paper-maker in Annonay, near Lyons. The ascent on the right was made at Versailles in the presence of the king and queen and a large body of spectators. In a cage hung to the balloon were a sheep, a cock, and a duck.

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and it attained for a short distance a speed of 18 miles an hour. In 1906 another Zeppelin traveled around Lake Constance, in Switzerland, turning curves and doing other "stunts" which proved the ease with which it could be steered. In 1908 another Zeppelin traveled 250 miles in 11 hours, but was wrecked in a storm. By this time Count Zeppelin's fortune was nearly exhausted, and the German government undertook to finance his projects.

The Zeppelin in the World War

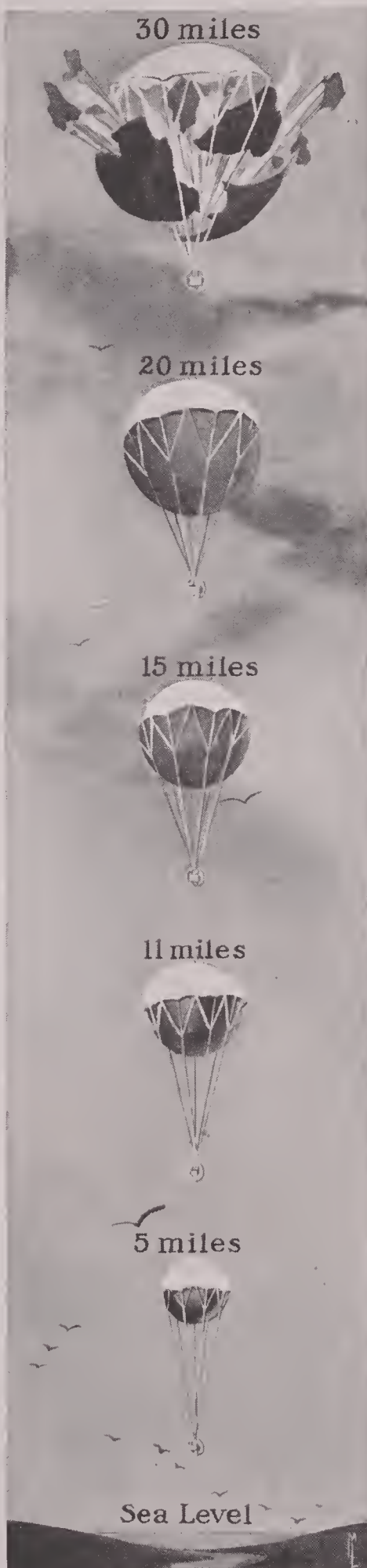
When the World War of 1914-1918 broke out, Germany was equipped with a fleet of giant Zeppelins, which were intended to spread terror in France and England. Although these vessels carried out several destructive bombing raids over England, they did not prove to be effective war machines. Their great bulk made them easy targets if they flew low enough to drop their bombs accurately, and as scouting machines they were surpassed by the speedier and far less expensive airplanes. The latter, indeed, were their greatest foes, since they were able to fly around and above them and set them on fire with incendiary bullets. Although Count von Zeppelin died on March 8, 1917, a disappointed old man, the principles worked out in these great balloons are proving highly useful in the peaceful navigation of the air today.

In the summer of 1919 a giant British dirigible, the R-34, built on the Zeppelin principle, made the first balloon crossing of the Atlantic Ocean. It sailed from a point near Edinburgh, Scotland, to Mineola, N. Y., in 108 hours, and three days later started back to England, making the return trip in 75 hours and 3 minutes.

The largest Zeppelins reached the enormous length of 760 feet, with a diameter of 75 feet. For such an immense frame aluminum was too fragile, so an alloy called *duralumin* was used. This consisted of aluminum with three

This shows how small India-rubber sounding balloons carry recording instruments to heights beyond the reach of man-carrying gas bags. As the balloon rises, the pressure of the atmosphere on the outside diminishes, allowing the gas inside to expand. The balloon keeps on swelling until finally the rubber bursts and the parachute brings the instruments safely back to earth.

A SOUNDING BALLOON



per cent of nickel, and was five times as strong and very little heavier than aluminum. These great airships carried from six to eight 240-horse-power motors, distributed through the forward, middle, and rear cars. The forward car, well up in the bow, contained, besides an engine room, the captain's cabin and the pilot room, where all the intricate instruments for controlling the huge sky-dreadnought were situated. Two cars were slung to the middle section, each of which held one or two engines, to drive the flank propellers high up on each side of the monster. The rear car hung some distance forward of the great rudder and elevator planes; it contained three engines driving three propellers, two up on the sides and a third projecting aft along the center line.

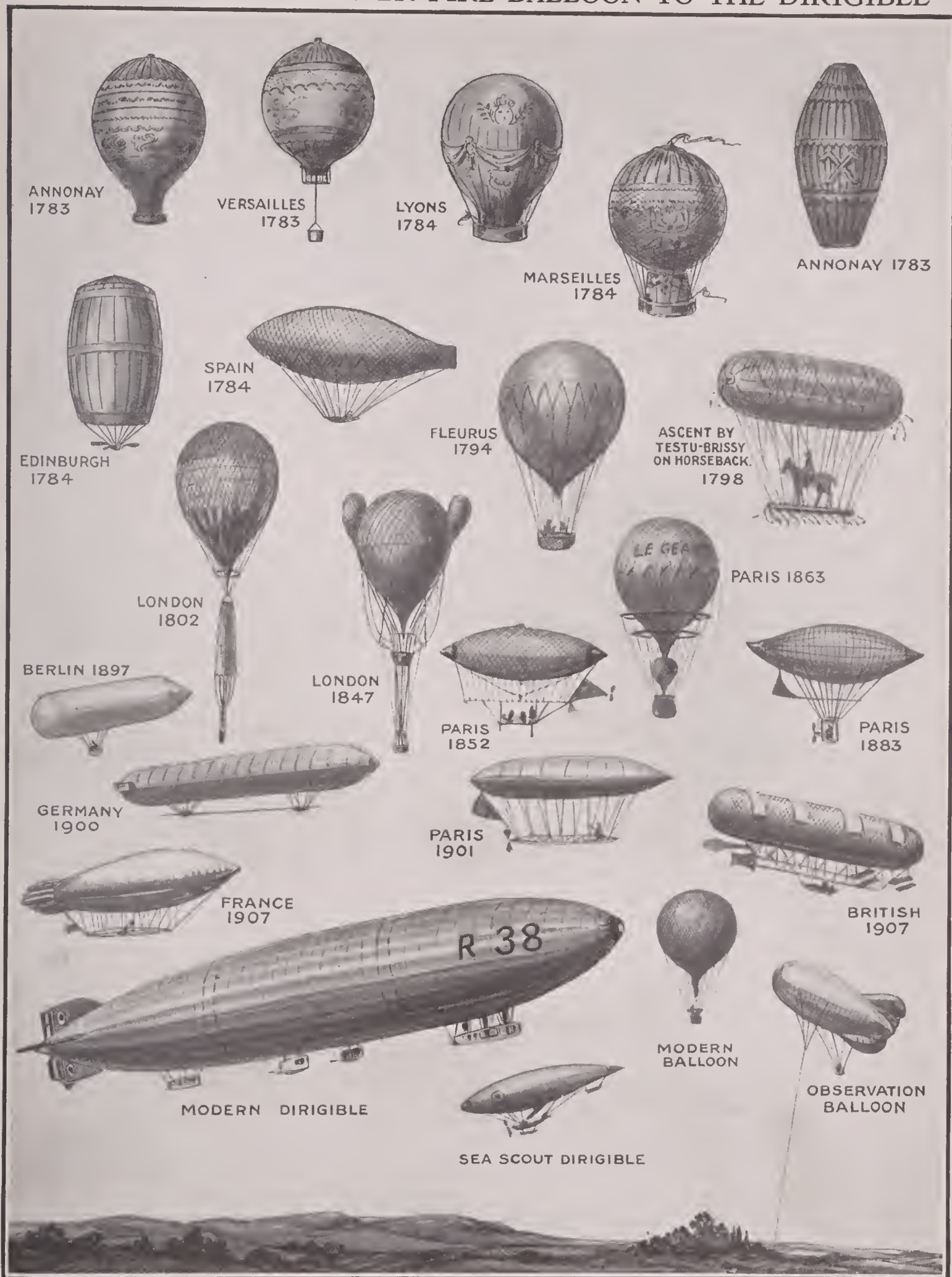
The "Cat-Walk"

Running the entire length of the ship, up inside the framework, was a long passage called, because of its narrowness, the "cat-walk." To make room for this passageway, each of the 16 gas bags in their various compartments had a V-shaped notch underneath, like a narrow wedge cut out of a pie. The cat-walk not only enabled the 20 or more members of the crew to go from car to car, but it provided them with sleeping quarters. Here also were stored the big gasoline tanks which fed the engines, and reserve supplies of bombs, spare parts for the motors, provisions, etc. A system of ladders led from the cat-walk to the cars beneath, and near the center a perilous climb between two of the gas-bag sections led through a narrow manhole to the very "roof" of the airship. The outer hull was then reinforced to form a long narrow path, leading to gun platforms near the bow and stern, where lookouts kept constant watch for hostile aircraft.

The best speed of the war Zeppelins was about 70 miles per hour. They had a lifting power of about 30 tons, in addition to their own

weight of about 30 tons. Their highest cruising

FROM THE MONTGOLFIER FIRE-BALLOON TO THE DIRIGIBLE



Here is the family tree, so to speak, of the modern balloons, beginning with the picturesque devices of the Montgolfier brothers in 1783 and 1784 and ending with the dirigibles and observation balloons used in the World War. Balloons used for scientific purposes have not changed much in shape, and it is interesting to note how the latest of the dirigibles resembles the aircraft produced in Spain in 1784 and the one in which Testu-Brissy made his daring ascent on horseback.

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THE START OF A BALLOON RACE AT PARIS



This shows one of the balloon races in Paris during the days of the greatest interest in this form of aircraft. One of the contestants, M. Fournoy, is just leaving the ground. This contest took place Sept. 11, 1912, and Fournoy covered 725 miles in 13 hours, 1 minute and 12 seconds.

altitude was between 12,000 and 16,000 feet. The estimated expense of building, equipping, and manning one of these larger Zeppelins was more than \$1,000,000. Several of them were brought down by British and French gunfire during the war, while others were forced to land after maneuvers to escape had exhausted their gasoline supply.

The experiments of the allied nations with dirigibles during the war were, on the whole, more successful than those of Germany, since they used such aircraft rather as defensive weapons. The British and American "blimps" of a small non-rigid type, carrying a single car slung amidships, with an engine capable of driving the vessel at 35 miles an hour, are believed to have destroyed more German submarines than any other single agency. Such vessels of the Allies cruised constantly over the North Sea and the British Channel, watching for the stealthy "U-boats," hovering above those that they found, and dropping

depth bombs upon them with considerable accuracy. Other coast patrol airships, built for the United States, Great Britain, and France, rendered great service in convoying transports and cargo ships through danger zones.

A BALLOONIST AND HIS SAND BAGS



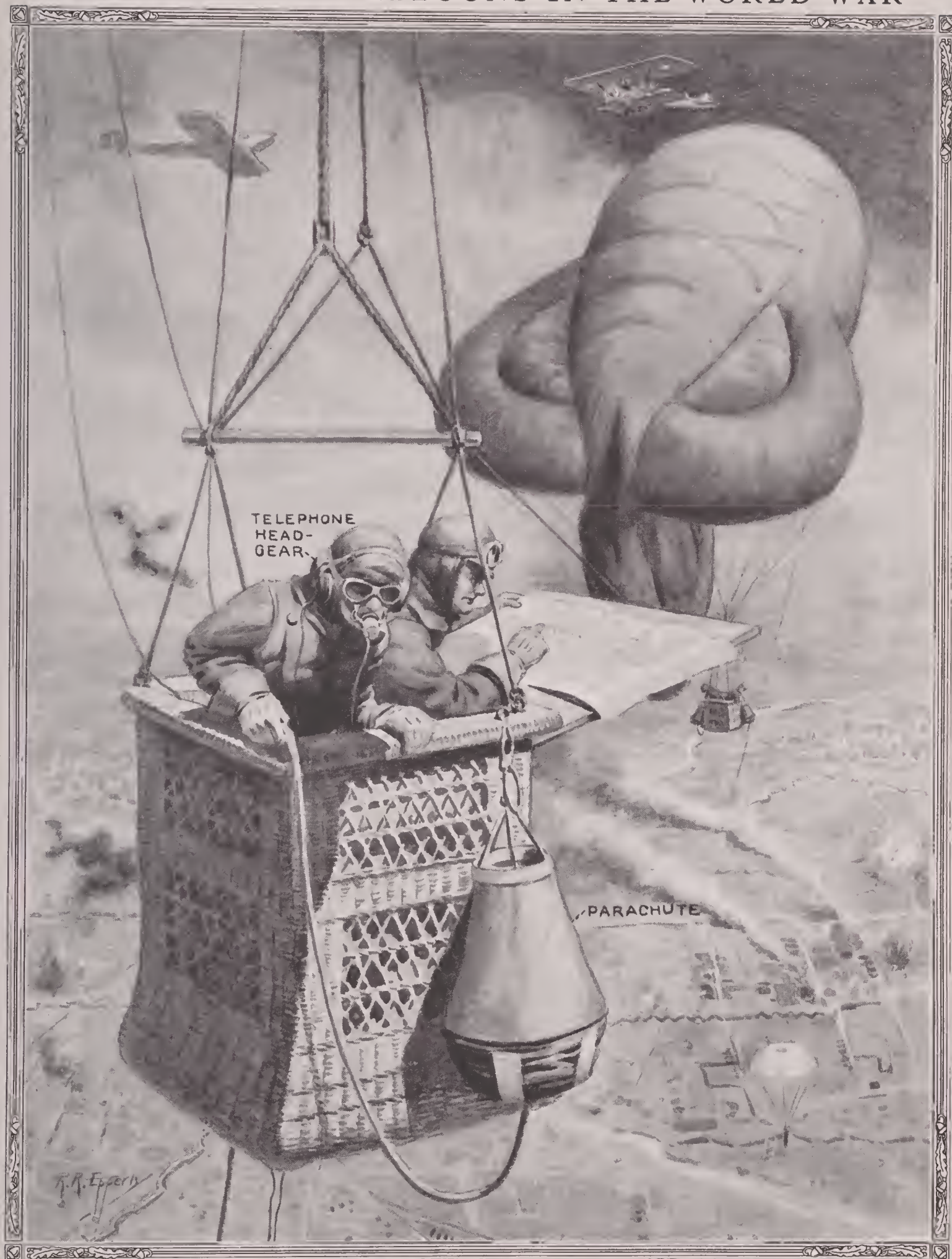
Balloonists carry bags of sand for ballast suspended from the outside of the car. As the bags of sand are emptied the craft rises, and pilots are thus able to check a too hasty descent.

"Sausages" or "Kite Balloons"

Of all the war balloons, the old "captive" form of balloon—now built of a "sausage" type—proved the most useful. Along every battle-line these "sausages" hobbled in the wind, while observers in the tiny baskets beneath telephoned to their artillery the information needed to guide the accuracy of the gunfire. They also reported the movements of enemy troops, and signalled messages to distant points when other means of communication failed.

These "sausages," which are still part of all army equipment, are usually given the official title of "kite balloons." Ordinary spherical balloons have a tendency to whirl around

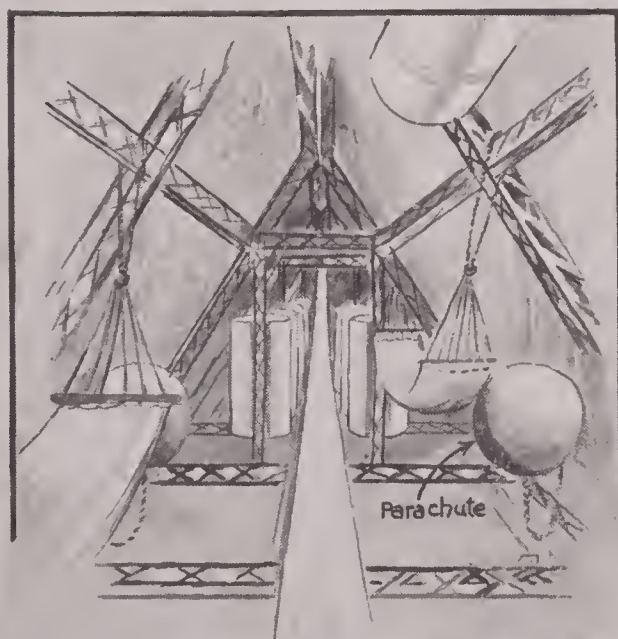
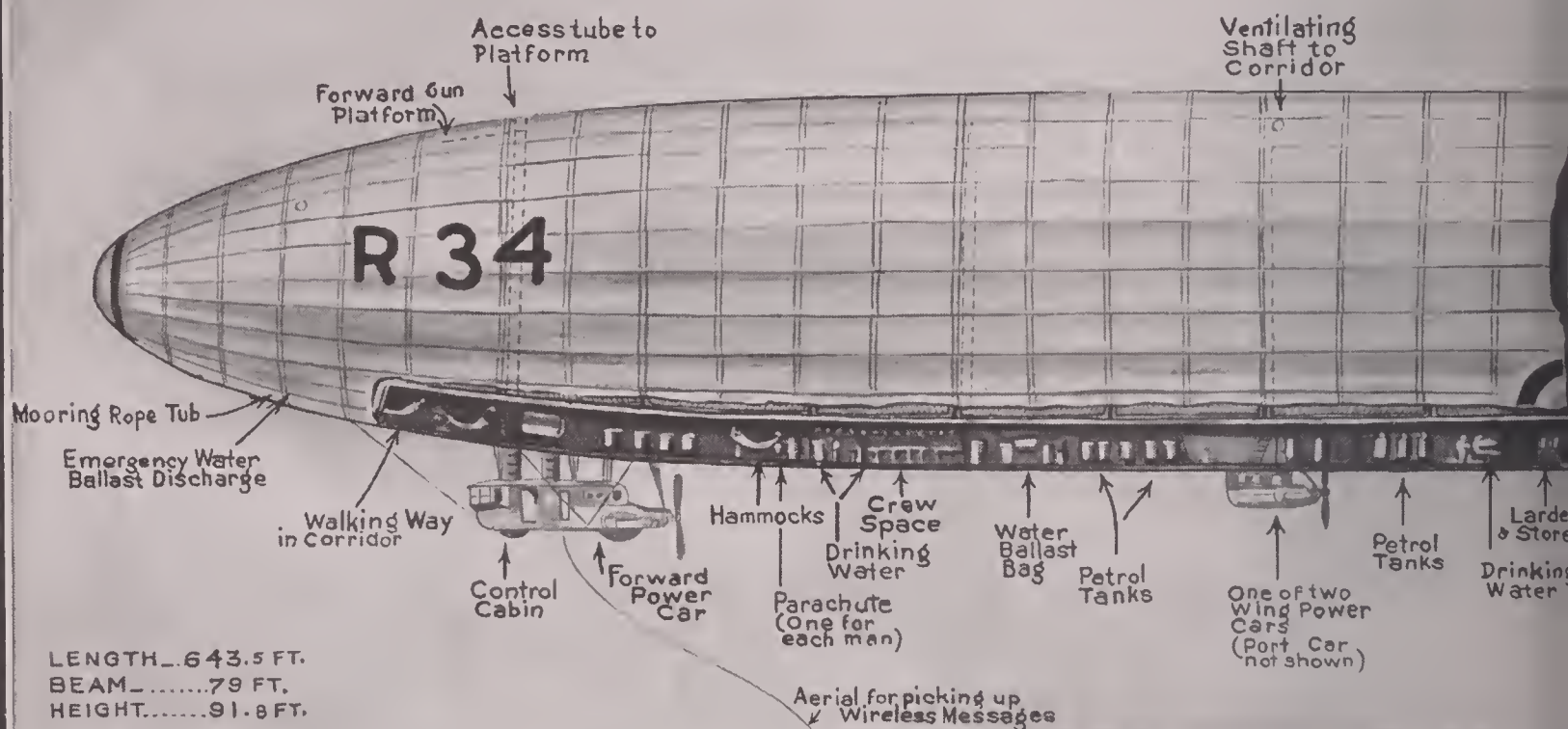
OBSERVATION BALLOONS IN THE WORLD WAR



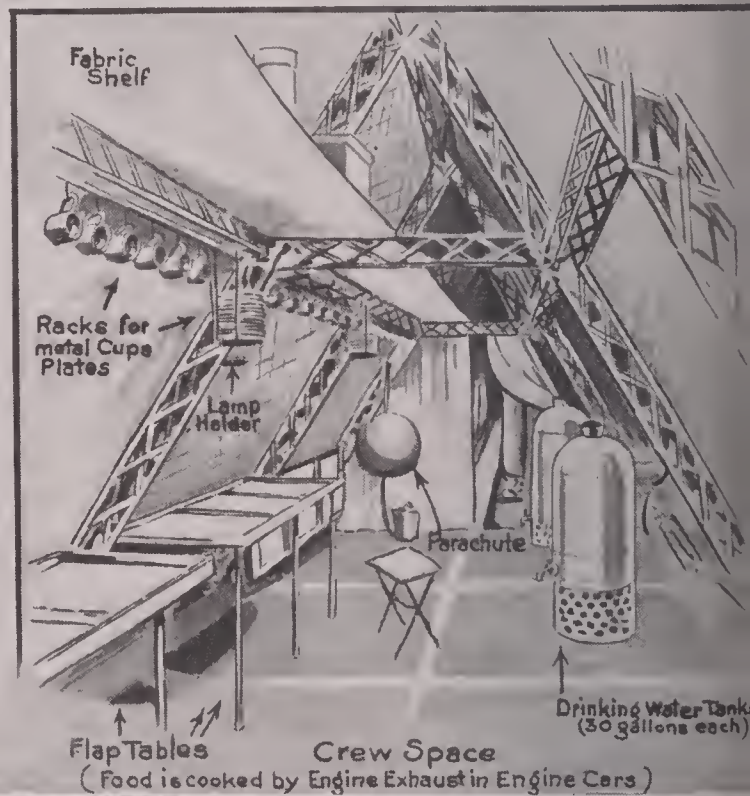
Swung in their baskets from these queer "sausage" balloons, the observers noted movements of the enemy and other facts of military value. One of the two men made the observations and checked up what he saw with the map of the territory spread out before him and called out the information to his companion, who telephoned it down to another man on the ground below. The telephone operator had the receiver attached to his ear and the transmitter to his mouth, just as the telephone girls do in the exchange, thus leaving both hands free. The parachutes were for use in case a well-aimed shot from an enemy airplane perforated the gigantic "sausage."

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THE FIRST TRANSATLANTIC LINER OF THE AIR



Inside the Corridor showing the Walking Way and some of the Hammocks Parachutes and Petrol Tanks

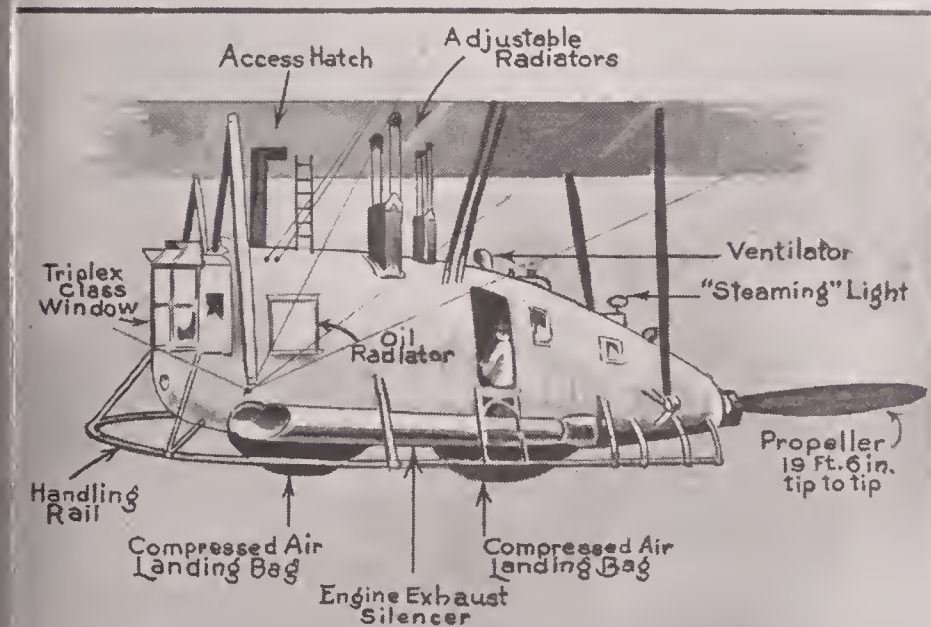
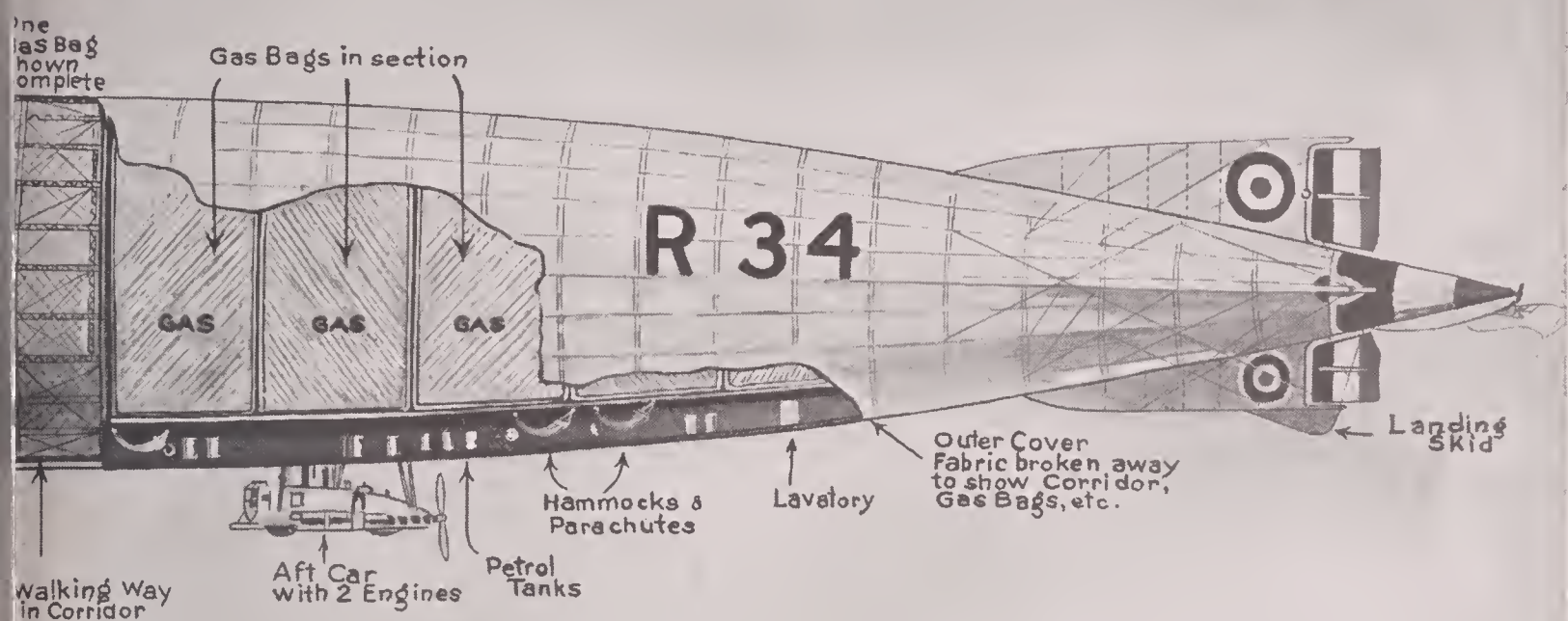


Here we can get a good idea of one of those queer flying fish called dirigibles. This is the British dirigible R-34, which made the first balloon flight across the Atlantic, July 2 to 6, 1919, in 108 hours with a crew of 31. The return trip was made in 75 hours. The hull is of stream-line shape, built of duralumin girders, and in sections of varying size. All along inside the keel is a triangular space, down the center of

which is a girder covered with ply wood about one foot wide which forms a "cat walk" or walking way. On each side of this is the fabric outer cover of the ship, which must not be trodden on. At intervals along each side of the gangway are fixed upright cylindrical tanks containing "petrol," as gasoline is known in England, and other apparatus, including a water-tank, parachutes, and hammocks. At one point, near the

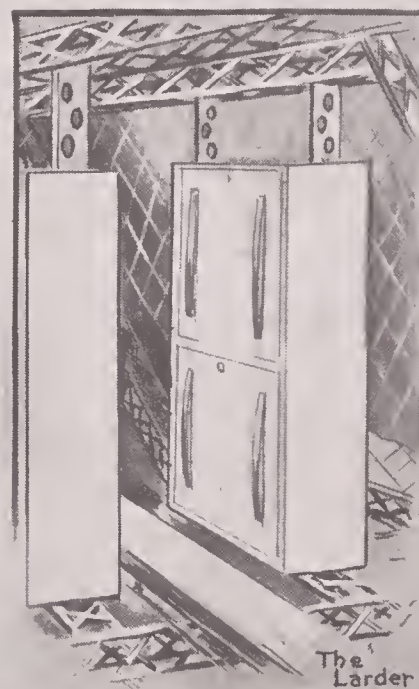
For any subject not found in its alphabetical place see information

ITS CONSTRUCTION AND MOTIVE POWER



The Aft Car

with two Engines coupled together
In this Car there are Auxiliary Controls for
use in case steering goes wrong forward.

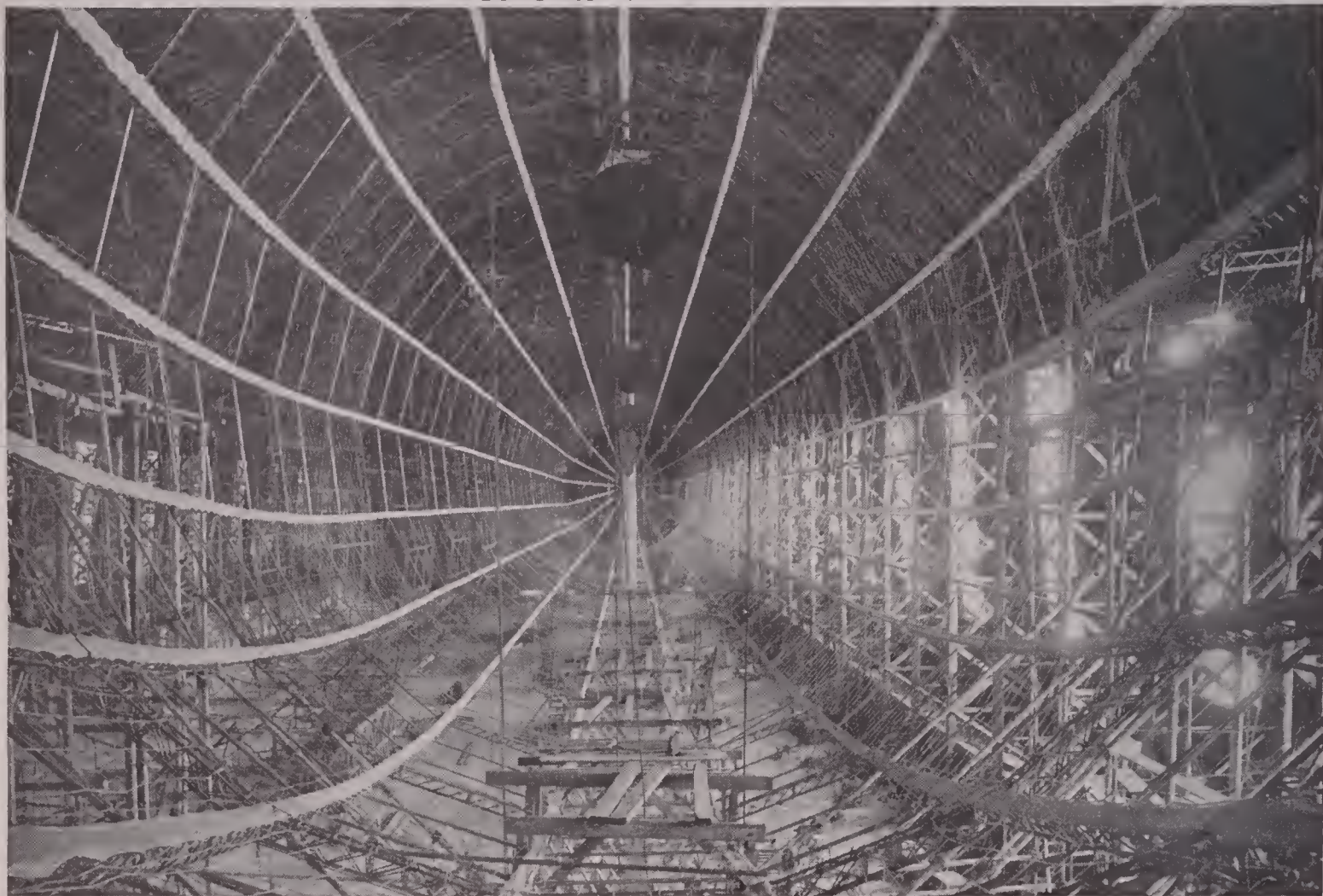


forward car, is the crew space. Here the whole width of the keel is floored in. Below the keel, and accessible by ladders, are four cars or gondolas. The forward car contains the control department—the “bridge” of the ship and (behind it) the wireless cabin. Amidships are two “wing” cars slung opposite each other a little way up either side of the hull. The aft car, like the forward car, is immediately

under the keel. The motive power consists of five 250-h.p. engines, one each in the forward and wing cars, and two in the aft car. At the after end of the hull are sets of planes, two for lateral and two for height control. A long tube running the entire height of the ship gives access to the forward gun platform. There are several bags of water for ballast to be let out in emergency so that the dirigible would rise.

contained in the Easy Reference Fact-Index at the end of this work

BUILDING A GIANT DIRIGIBLE



A gigantic spider's web? No, we are looking into the R-34 in process of construction. The framework has been completed and the outer covering is being put into position. During the World War, when most of the men were away fighting, the girders for the hull of these aircraft were assembled and riveted by girls with pneumatic hammers.

rapidly and to "bob" and "buck" when they are restrained by a ground cable. To overcome this tendency the new gas bags are sausage-shaped, and rigged so that they rise in a slanting position. At the lower end is a separate compartment called a "ballonet," with an opening into which the wind rushes, creating sufficient pressure on the gas bag itself to keep it always fully distended and so prevent it from buckling. Wings, which are sometimes mere flaps of cloth, and sometimes are inflated extensions of the ballonet itself, project on each side. Below the ballonet is another air-catching bag, shaped like the curved end of a sausage. This is called the "steering bag" and serves to keep the under side of the whole balloon facing the direction from which the wind is blowing. Even with these strange-looking devices, only persons not subject to sea-sickness are able to withstand the vessel's heaving and tossing. The "sausages" can ascend to 1,500 feet on calm days, but their limit is very much lower in stiff winds.

Fire, the Dread of the Balloonist

Fire has always been the greatest dread of balloonists. The flimsy bag above them filled with hydrogen or coal gas is ready to burst into flame at the slightest spark. Hundreds of lives have been sacrificed in this way; so scientists sought ceaselessly for a non-inflammable gas which was lighter than air and could be

produced in sufficient quantities. The gas helium was known to be non-inflammable and much lighter than air, but it was not until the World War was nearly over that American scientists discovered how to produce it cheaply enough and in sufficient quantities for use in balloons (*see Helium*).

But though helium came too late to be of use in the war, it has revolutionized ballooning for subsequent ages. Inflated with helium, the great airships of the future will sail among the clouds more safely than the ocean liner crossing the Atlantic. Lightning storms will have lost their terrors for the balloonist. The motors, which in the past had to be placed as far away from the gas bags as possible, may now be drawn up inside the bag, if necessary, thus gaining greater speed through less resistance.

Airplanes will probably always outnumber balloons on the highways of the sky, and they will be found cheaper and more useful for rapid transportation. But the great dirigibles which can lift many tons and float more calmly, giving passengers all the conveniences of steamer travel, will always have an important place in commerce and travel.

BALLOT. The word "ballot" means "little ball," and our use of the term comes from the early practice of voting by colored balls. A white ball meant a favorable vote, and a black ball an adverse vote; from

this comes the expression "to blackball" a person, meaning to vote against admitting him to a club or similar organization.

Some form of balloting has been in use for centuries, but the use of "voting papers," or the ballot as we know it today, is of recent origin. As early as 1634 the freemen of Massachusetts Bay Colony demanded the written ballot instead of the usual "raising of the hands" in choosing a governor, in order that they might drop the aristocratic and unpopular Governor Wintthrop from office. This was only an isolated case, however, and although a few states adopted the ballot system of voting in their new constitutions after 1776, *viva voce* voting (by "living voice") remained the general method in use. According to this the voter came to the polling place and announced publicly the names of the candidates for whom he voted, as was the custom of Great Britain until the adoption of the ballot there in 1871. This method encouraged vote-buying and intimidation; for when a vote was bought "the goods were delivered" in the buyer's presence; a voter was often influenced to vote against his better judgment because of fear of the ill-will of his landlord or employer if he voted against the latter's candidate.

The states of the American Union gradually abandoned *viva voce* voting, although it continued in some of the Southern states until after the Civil War. Unofficial written ballots were at first substituted for the *viva voce* method, each voter preparing his own ballot. Then the candidates began to print their own ballots; and later the political party had its ballots printed, each party using ballots of a different color. But still the ballot was not really secret, and corruption continued.

The next change came in 1888 when the states began to adopt the secret official ballot known as the "Australian ballot," because it was first used in Australia. There are two forms of this ballot, and one or the other is now used in every public election in the country. They are the "party column" and the "office column" ballots. On the first, the names of all the candidates of each party for various offices are arranged in a vertical column under the party's name; usually there is a circle at the top, and the voter can vote "a straight ticket" by placing a cross mark in it. In the other form of the ballot, which is the one used in Australia, the names of the candidates of all parties for a given office are placed in alphabetical order, giving each candidate's party connection after his name.

The second type requires more intelligent voting, but it is impractical in elections where the number of candidates is very large. As the number of elective offices has increased, the ballot has grown to unmanageable size, sometimes containing more than 400 names. These "blanket ballots" have become so complicated that it is difficult to vote intelligently, and for this reason an agitation has been started for a "short ballot" reform. This movement advocates the reduc-

tion of the number of elective offices by making minor offices appointive. In this way the size of the ballot may be reduced and simplified, and the voter can choose more intelligently. At the same time he may keep control by the use of the recall. (*See Initiative, Referendum and Recall.*)

Since about 1892 various types of machines have been in use for casting and counting votes. These voting machines are operated on the same principle as calculating and tabulating machines. (*See Calculating Machine.*)

BALTIC SEA. The great arm of the North Sea which lies between Sweden, Denmark, Germany, Finland, and the former Baltic provinces of Russia, is the Mediterranean of northern Europe, and has for centuries been the chief highway by which the trade of that region has been carried on. It is chiefly by way of the Baltic that Russia has its outlet to the Atlantic. Russia's "window to the west" was obtained by Peter the Great, who early in the 18th century built his new capital, St. Petersburg—now called Petrograd—on the Gulf of Finland.

The "window" is closed three or four months of the year by ice. This is due not only to the fact that the Baltic region has a cold winter, but also to the fact that its waters contain only about a quarter as much salt as the ocean, and so freeze more readily. A fifth of the surface of Europe drains into it, through more than 250 rivers, among them the mighty Oder, Vistula, Neva, and Niemen. This enormous flow of river water, added to the fact that there is little chance for the water from the ocean to enter the Baltic through the narrow passages connecting it with the North Sea, explains why the waters of the Baltic are almost fresh. The narrow straits of the Sound, Great Belt, and Little Belt, and the Cattegat and Skagerrack furnished the only outlet to the Baltic until 1895, when the German government completed the Kiel Canal across the base of the Danish Peninsula.

Even when the Baltic is open to navigation, it is dangerous to seamen because of its extreme shallowness on the German coast, the ruggedness of the Swedish coast, and the frequent violent storms accompanied by sudden changes of wind. The greatest width is about 400 miles and the length is 960 miles. As in other inland seas, the tides are scarcely perceptible. The broken coast line—about 5,000 miles in length—furnishes some good harbors, the most important being Riga, Copenhagen, Kiel, Danzig, and Stockholm. The north part of the Baltic is called the Gulf of Bothnia; on the east are the gulfs of Riga and Finland.

The Baltic was the scene of a naval battle between the Danish and English fleets on April 2, 1801, known as the Battle of the Baltic, or the Battle of Copenhagen, in which the British seized or destroyed the Danish fleet to prevent its falling into the hands of Napoleon. At the beginning of the World War of 1914-18 there was some fighting between the Russian and German navies in the Baltic, but during the greater part of the war the German warships lay there useless. Although they had an outlet through the Kiel Canal, they seldom ventured forth, for England's fleet commanded the North Sea. The former Baltic provinces of Russia proclaimed their independence in the course of that conflict. (*See Esthonia; Latvia; Lithuania.*)

BAL'TIMORE, MD. Baltimore is the principal city of Maryland, the eighth in population in the United States, and the largest city of the Atlantic seaboard south of Philadelphia. It is situated in the north central part of the state, on the Patapsco River, 14 miles from Chesapeake Bay and about 200 miles from the sea. The river is really an arm of the Chesapeake Bay, and it has been widened and improved to form a land-locked harbor, 12 miles long and 3 miles wide, capable of accommodating the largest steamships. Forts McHenry, Armistead, and Howard stand between Baltimore and the sea.

Days of the Baltimore Clippers

Baltimore has been an important seaport since the early days of its history, when its fame was carried far and wide by the world-renowned "Baltimore clippers," picturesque sailing vessels no longer in general use. Today, the boats of more than 50 steamship companies, mostly transatlantic services, regularly visit the city, making it the center of a great export and import trade, ranking third among American ports. Baltimore is the largest corn-exporting port in the United States, and it also exports large quantities of wheat and other grains, flour, cotton, tobacco, copper, and coal. Articles of import include wood pulp, bananas, pineapples, sugar, and general merchandise.

The city has forged ahead rapidly as a manufacturing center since the beginning of the 20th century. Its largest single product is men's clothing; the production of tin, copper, and sheet iron ranks second. In addition Baltimore manufactures fertilizers, straw goods, and three-fourths of the sail duck made in the United States. Recently Baltimore has become one of the most important shipbuilding centers in the country. There are also large slaughtering and meat-packing plants, oyster fisheries, and fruit-canning establishments. One of the largest copper-refining plants in America is located here, and the Bethlehem steel works at Sparrows Point has a daily capacity of 2,000 tons.

Baltimore has many beautiful parks, with a combined area of nearly 1,400 acres, widely scattered over the city. Druid Hill Park, the largest, contains a statue of Christopher Columbus erected in 1792. In Westminster Cemetery, one of the oldest and smallest cemeteries in the city, is the grave of Edgar Allen Poe. The Washington monument and the Battle monument, erected shortly after the War of 1812, gave Baltimore the name "The Monumental City." The Washington monument, a noble shaft of marble 164 feet high, surmounted by a heroic statue of Washington, was the first memorial erected in honor of Washington.

One of the most notable of the many beautiful public buildings is the courthouse, built of white marble, containing mural decorations by the noted artists Blashfield and Turner. The city is the see of a Protestant Episcopal bishop and of a Roman Catholic cardinal (Cardinal Gibbons), whose diocese is the first in the United States.

Many schools and colleges are located here. The Johns Hopkins University, one of the world's great educational institutions, was established in 1876. Connected with it is the Johns Hopkins Hospital, one of the best equipped hospitals in the world. The Baltimore College of Dental Surgery is the oldest of its kind in the United States, and Goucher College is one of the oldest of women's colleges. The Peabody Institute contains a famous historical library.

Youngest of the Great Atlantic Cities

Baltimore is the youngest of the great American cities on the Atlantic coast. It was founded in 1729 for the purpose of establishing a port near the head of Chesapeake Bay. Originally it consisted of 60 acres, and was named in honor of George and Cecil Calvert, Lords Baltimore, who founded the colony of Maryland a hundred years before. In 1745 it consolidated with a little town, settled in 1732, directly across Falls River. Baltimore was included in Baltimore County at first, and became the county seat in 1767. Later, however, the city and county were divorced, and Baltimore today has an independent government from the county.

During the Revolutionary War, Baltimore housed for a while the Continental Congress, after that body was forced to retire from Philadelphia. In 1789 it became a port of entry, and in 1796 was incorporated as a city. In the War of 1812 the city was unsuccessfully attacked by the British. It was the sight (Sept. 14, 1814) of the American flag flying over Fort McHenry after a night of British bombardment that inspired Francis Scott Key, who had been detained by the British during the battle, to write the national anthem "The Star Spangled Banner." The first blood shed in the Civil War was in Baltimore, April 19, 1861, when a mob sought to prevent the passage through the city of the 6th Massachusetts and the 7th Pennsylvania regiments, then on their way to Washington in response to Lincoln's call for volunteers.

First City Lighted by Gas

Baltimore was the first city lighted by gas; the first steam passenger train in America ran from Baltimore to Ellicott City; the first steamship to cross the Atlantic sailed from Baltimore; the first electric telegraph line was strung from Washington to Baltimore; and the first submarine to cross the Atlantic Ocean, the German U-boat *Deutschland*, docked at Baltimore. In Baltimore also were built the first linotype machine, the first iron steam vessel, and the first armor plate.

The entire business section of Baltimore was destroyed by fire, Feb. 7 and 8, 1904. The property loss was great, amounting to more than \$70,000,000. Later, however, the fire came to be regarded as a blessing, as the burned section rose from the ashes in new buildings of the most modern type. Extensive improvements were made on the waterfront, which included an elaborate system of concrete piers; the old narrow streets were widened, and an extensive sewer system was built. Population, about 735,000.

BALZAC (*bäl-zäc'*), HONORE DE (1799–1850). This great French novelist was a heavy, bulky, dreary man, who seemed to radiate strength and to turn off novel after novel, most of them masterpieces, with one



HONORE DE BALZAC
Giant of French Novelists

shake of his massive inspired head. There have been other novelists who threw a stronger beam of light on certain corners of life, but few who so widely and brilliantly illuminated the whole of it. Balzac was the first French writer who sought to place on his pages our

life entire—its good, bad, and mediocre points; its weak, strong, happy, sad, struggling, noble, and base sides—in one welter together. His stories are as lifelike as though someone had pointed a motion picture camera at the scenes and people he writes of; only Balzac did more. The lens of his genius and his great understanding soul could look deeper than the surface of a picture. It could see through into the minds and hearts of people, and show how one event dragged another with it, and how one man's life was fatally linked with another. The motion picture shows us a street full of people mysteriously rushing about. Balzac can show us where they are going, what will happen because they go there, and what they are thinking about while they go that makes their eyes so bright or their lips so pale. He shows them as a part of the entire great world, not as little desperate interesting fragments. That is why he is said to have "a sense of the whole," and why his books are so clear, even in their wide detail. His famous series of novels called 'The Human Comedy' was intended to be a complete picture of modern life.

But when we learn that he wrote 85 of these wonderful lavish novels in 20 years, we inquire what was the hidden dynamo which drove this indolent, sentimental heavy man to such a flood of energy, when he really liked to live easily, collect fine old furniture, keep a good cook, and chat with a few old friends. Let us examine his history to find out.

He was born at Tours, educated there and at Paris, where he was an insatiable reader rather than a brilliant student. He studied law, failed in its practice, and until 1829 wrote worthless "pot-boilers" for the money they brought. Then his 'Chouans' was published, and his real work began. In 1834 he met the lovely Countess Hanska, a Polish beauty whom he worshiped at a distance and through a long correspondence, until at last they were married in 1848. But their great difference in social position and wealth forced him to compel the favors of fortune. He wrote like

a slave, whipped his nerves with black coffee, stuck hours at his desk, engaged in wild financial speculations, to grow rich and marry his countess. He was always, like Sir Walter Scott, fighting against debt. When his fame was so brilliant that he was the social equal of the countess, and when his finances permitted, he attained his dream of marriage with her—only to die two years later, wrecked by his frenzy of work in the years before.

Balzac's chief works are: 'Les Chouans' (1829); 'La Peau de chagrin' (The Wild Ass' Skin), 1829; 'Le Curé de Tours' (1832); 'Eugénie Grandet' (1833); 'Le Lis dans la vallée' (The Lily of the Valley), 1835; 'Le Père Goriot' (Old Goriot), 1835; 'César Birotteau' (1837); 'Ursule Mirouet' (1841); 'La Maison Nucingen' (The House of Nucingen), 1846; 'Le Cousin Pons' (Cousin Pons), 1846; 'La Cousine Bette' (Cousin Betty), 1847.

BAMBOO. The colossal treelike grass called bamboo has been well styled "one of the most wonderful and most beautiful productions of the tropics, and one of Nature's most valuable gifts to man." It is a gift, too, with which Nature has been most generous, for more than 200 species of it are found in Asia, South America, and Africa. A single root may grow as many as a hundred polished jointed stems rising 30, 50, or even 120 feet in the air. There are no limbs

A NEW ROADWAY EVERY MONTH



Bamboo grows so fast that, if the roadways are not constantly kept open, like this one in East Africa, they become overgrown in 30 days.

except at the very top. Some species are three feet around. The rate of growth is often very rapid, in some cases as much as a foot a day.

The uses of the bamboo are innumerable. Everything from a house to a pen-point is made of it. The young tender shoots are cooked for food as we use

asparagus, and they form part of the familiar Chinese dish called "chop suey." They are also pickled in vinegar and candied with sugar. The seed of those species whose fruit is a grain, like barley and rye, is also eaten, and the Chinese have a proverb that the bamboo seed is more plentiful when the rice crop fails. Some species have a fruit, not unlike an apple, that is baked and used as food.

But it is the hollow tubelike stem of the plant which is most useful. It is used for the posts of houses. Split into strips it forms the planks for floors, roofs, and sides. Besides the familiar fishing-rod, it is also used for water-pipes, bridges, and cables, and the joints of the large stems are even used for pails and for cooking utensils. Strips are woven into mats, chairs, beds, cradles, cages, porch curtains, and other articles of furniture. Chopsticks, hairpins, phonograph needles, and the ribs of fans are made of bamboo, and from the interior portions, beaten into a pulp, is made a fine variety of paper. The outer skin of some species is so hard that native knives and swords have been made from it, with a sharp and durable cutting edge.

Some species of bamboo are cultivated in greenhouses and gardens in Europe and America for their ornamental value.

BANANA. The story of the banana industry is one of the wonderful romances of this modern age. Not very long ago this fruit was a luxury in temperate regions and a little-known luxury at that. The tall broad-leaved plant was cultivated by white settlers and natives in tropical lands only for their own use. The first bananas brought into the United States came about the middle of the 19th century, and for several years they were merely expensive novelties at some of the southern and eastern seaports.

The Romance of the Banana

Then Captain Baker, the owner of a Cape Cod schooner, getting ready to return home from a trip to Jamaica, looked around for a cargo. Because other freight was lacking he purchased a few bunches of green bananas. He made a quick voyage and docked in Boston with the bananas ripened and in fine condition. Hunting up his friend Andrew W. Preston, he said:

"Preston, I've got some fine tropical fruit for you."

"What kind of fruit?"

"Bananas."

"Bananas! I can't sell bananas. By the time they get here they're so decayed they're ready to throw away."

"Is that so? Look at this," and he pulled out of his pocket a fine golden-yellow specimen very much like the fruit we are so fond of today.

The fruit dealer took the whole lot. He realized the great commercial possibilities of the fruit if it could be transported without spoiling; and investigating the possibilities, he laid the foundation for the great banana industry. Later he became the president of the United Fruit Company, which imports more than half the bananas brought into the United States today, and which has done more than any other

organization to bring the banana within the reach of every consumer.

But the task was by no means a small one, for the obstacles with which he had to contend were as discouraging and varied as the tangled forests and swamps of the tropics could make them. Transportation of the fruit was only a small part of the problem, for banana plantations themselves had first to be started. Contrary to common belief, most varieties of the wild banana do not bear edible fruit, but only a long pod filled with large seeds surrounded by very little pulp.

Forests had to be cleared and swamps drained; railroads had to be built, bridges thrown across mighty streams, safe harbors made, and a fleet of specially constructed ships provided so that the fruit could be speedily transported. Today millions of acres of land are under cultivation, and bananas are raised on most of the islands of the West Indies and along all the Gulf and Caribbean coasts from Vera Cruz to the mouth of the Amazon. Central America is the greatest banana-producing area in the world. Cities with good schools and hospitals have been built where only a few years ago were disease-breeding jungles. Not only do the natives of these countries grow bananas in large quantities, but many persons from the United States and Canada have settled there and started plantations. The banana is also an important crop in the Canary Islands, throughout the Pacific islands, some parts of Africa, the Malay region, and the East Indies.

Why Bananas are Picked Green

Bananas are seldom allowed to ripen on the trees. The tree-ripened fruit matures so quickly that the skin breaks, and ants, bees, and other insects feed upon the pulp, spoiling it. So the bananas we buy in the store taste about the same as they do in the tropics, because they are cut green in either case.

There are, however, many delicate varieties that cannot be exported because of their tender skin. Among these is the little straw-colored "lady finger" banana of the Canary Islands, which when fully developed is only three or four inches long, and has a melting pulp and exquisite flavor. The Mensaria Rumph, the "best of all bananas" of the Malay Archipelago, has a soft pulp scented as if with rose water. Other specially prized varieties are the Lacatan, a very sweet greenish-yellow banana of the Philippines, and the Champa of India, which rivals the pear in lusciousness.

There are nearly 70 known species of banana. Some of these, known as plantains (*Musa paradisiaca*), are "cooking bananas" and are almost never eaten raw. The fruit of one kind of plantain grows to an enormous size, sometimes two feet in length and as thick as a man's arm. Plantains constitute one of the chief foods of the natives in the tropics, taking the place of our bread and potatoes, but they are seldom exported as they are not in demand where potatoes are available.

FROM PLANTATION TO STEAMER



In this banana grove in Costa Rica bunches of the green fruit are piled on the platform ready to be hauled over the narrow-gauge railroad to the point of shipment. Notice the height of the banana plants compared with the men on horseback.

Banana "figs" are sold in large quantities in tropical countries as sweetmeats. They are ripe bananas which have been preserved by sprinkling with sugar and drying in the sun. Banana flour, prepared by drying unripe bananas and grinding, is largely used in the tropics. The flower clusters of some species of the banana plant are considered a delicacy in India. They are generally cooked in curries.

But That Isn't All the Banana Does

With all these food uses you would think that the banana plant had done enough for man. Its broad leaves, however, are often torn into strips and woven into mats and coarse cloth; and the fiber which they contain is in common use by the natives for cordage and to some extent for paper. Indeed, one of the most important fiber plants that we have, from which comes the manila fiber used so largely for twines, ropes, and wrapping papers, is a close cousin to the plants which produce these tropical fruits, its scientific name being *Musa textilis*.

A banana plantation is a magnificent sight, often extending over thousands of acres. The tree-like plants grow to a height of from 10 to 40 feet, and the great drooping leaves, 6 to 10 feet long and 1 to 2 feet wide, meet in arches that shut out the light of the sun. The plants grow from rootstocks and are usually propagated by shoots of the parent stem. They

are planted in rows, very much like rows of corn, although they are set much farther apart to make room for the spreading leaves. The true stem is underground, but there is a stalk often a foot or more in diameter at the base, made up of the sheathing bases of the leaves, which protects the flowering stem as it pushes its way upward. Soon a long "bud" appears, made up of tightly overlapping purple scales, each of which protects a cluster of true flowers. The lower clusters wither and only the upper ones are fertilized and produce fruit. The bananas grow around the stem in ridges called "hands," the standard sized bunch being nine hands to a stem, and 10 to 15 "fingers" to a hand. When the bananas are small they point out-

ward but as they grow larger they bend upward and in toward the stem, and so grow with the ends turned up. The bunches we see hanging in our stores are thus *upside down*.

These two humble servants of the public keep going back and forth all day long on the narrow tracks hauling the fruit to the docks.



Here the bananas are being put into the hold of the vessel. The two men standing near the hatchway are holding up a particularly fine bunch for you to look at.

The banana plant grows and produces fruit in from 12 to 18 months. Each plant produces but a single bunch of bananas and after the harvest is cut down; but new shoots soon spring from the old root stock.

"Big Mike" and the Rest of Them

The green bunches, packed with banana leaves, are taken quickly to a seaport, loaded by automatic con-

veyors into ships, kept cold by fans and refrigerating plants, and at the end of the voyage discharged into freight cars by canvas belts with pockets.

Most of the bananas sold in the United States belong to the species known as "Gros Michel," which roughly translated means "Big Mike" (*Musa sapientum*); it is the large smooth yellow product of Jamaica and Central America. The Canary Island banana (*Musa cavendishii*), better known as the dwarf Chinese banana, is quite extensively raised in some sections of Central and South America, where other types cannot be raised because of a soil disease to which the Chinese banana is immune. It is smaller than Gros Michel but finer in flavor. The red Jamaica banana or baraoa is grown in various parts of the world, including the American tropics, and while it is popular with the public it is difficult to ship because the individual bananas do not cling closely to the stem.

BANGKOK', SIAM. Until recent times Bangkok, the capital of Siam, was the Venice of Asia. Not only was its commerce carried by water, but a large proportion of its people lived in houseboats on the river Menam. Now, however, the city has been modernized. Wide thoroughfares, carried across the canals by bridges, are lined with brick buildings, lighted by electric lamps, and traversed by electric street-cars. The new city surrounded by high walls has been laid out around the royal palace and its parks, which form the center of local interest. The modern aspect of this new section contrasts strangely with the numerous Buddhist temples, whose gilded spires and decorated roofs of carved teak-wood are found in all directions.

Lying only 20 miles from the mouth of the Menam, Bangkok is the center of the foreign trade of Siam. The chief exports are rice and teak, and its imports are cotton and silk goods, foodstuffs, machinery, and oil. Most of its trade is in the hands of Chinese and European merchants. Population, about 540,000, of which 200,000 are Chinese.

BANJO. The negro of the South made the banjo famous, for this most commonplace of musical instruments in his hands will crash out the liveliest of tunes, or sob like a human heart. The negro poet, Paul Dunbar, sings its praise:

. . . I jes' lets down
A banjo string or two
Into the deepest of my heart,
An' draws up chunes for you.
Slowly dey comes swingin' up,
Aquiv'rin' through an' through,
Till wid a rush of tinglin' notes
Dey reaches light—an' you!

The banjo has a round tambourine-like body formed of parchment stretched over a frame, and a long neck. The catgut strings, usually five in number, are plucked or struck with the fingers of the right hand while the fingers of the left hand lengthen or shorten them by pressure against the fretted neck. The negroes are believed to have brought this instrument with them from Africa.

BANKRUPTCY. In the days of the later Middle Ages, when the Italian cities were the money markets of the world, it was the custom to break the bench of any money-lender or banker whose debts became

greater than the amount of his property. As his bench was his place of business, the breaking of it forced him to discontinue his former pursuit, and also implied disgrace. From the words describing this custom (*banca* meaning "bank," and *ruptus* meaning "break") has come our modern word "bankrupt"; and from the custom itself comes the practice of all modern nations of forcing a man who cannot pay his debts—that is, who is a bankrupt—to discontinue his business. This is done by means of bankruptcy laws.

When the fathers of the United States drew up the Constitution, they put in it the provision that "Congress shall have the power to establish uniform laws on the subject of bankruptcies throughout the United States." At first this power was seldom exercised, for most business was local in character and the regulation of it could readily be left to the individual states. In 1800, 1841, and 1867 federal bankruptcy laws were passed, but each was of an emergency character and remained in operation only a few months or years. When business operations began to expand, and a man's creditors would often live in a dozen different states, it was necessary for Congress to provide a permanent federal law on this subject, and in 1898 the present bankruptcy law was passed.

According to this law there is voluntary and involuntary bankruptcy. Any debtor may become a voluntary bankrupt by filing a petition with the judge of the United States District Court, setting forth the fact that he is unable to pay his debts and that he is willing to surrender all of his property to his creditors. Any person or corporation (except laborers, farmers, and national banks) who owes \$1000, or more, may be declared an involuntary bankrupt by the district court, if he in any way attempts to cheat his creditors, or if he admits in writing his inability to pay his debts. In this case the creditors must file the petition.

After a petition has been filed, either the judge of the court or a referee in bankruptcy to whom the judge may refer the case appoints a day on which the creditors may present their claims. If it is decided that the debts of the man are, as is claimed, greater than his property, he is declared bankrupt, and his property is handed over to a trustee. The trustee sells the property and divides the proceeds among the creditors in proportion to their claims. As soon as the settlement is finished, the debtor is discharged from bankruptcy and the remainder of his debts is canceled.

In this way both creditor and debtor are protected. The debtor cannot continue contracting debts and so lessen the amount which each of his creditors will receive; each creditor, also, is assured of receiving his fair share of the bankrupt's property. On the other hand, after the bankrupt is discharged from bankruptcy he is able to start business anew, without the burden of the old debts which he could never hope to pay. It is more profitable for the creditor than the old method of imprisoning the debtor for debt; and

it is also more just to the honest debtor, for in this day of complicated business enterprises, a man often may become a bankrupt through no fault of his own. The chief difficulty arises from dishonest debtors who conceal their property and seek to free themselves from their debts by fraudulent bankruptcy proceedings. This, of course, is contrary to the law. The early law of Rome gave a man's creditors, if he could not or would not pay his debts, the savage remedy of dividing his body among them, or selling him and his family into slavery.

BANKS AND BANKING. In every town of the country, no matter how small, there is usually at least one building with the word "bank" painted on its windows in large gold letters. This is the financial center of the whole community, and upon it business success depends.

Many people consider a bank as a place merely for the safe-keeping of money which they do not need immediately. This function alone is of immense value to society, but a bank does much more. It is a lender as well as a borrower of money. From it, for example, a farmer may obtain money in October with which to buy a carload of cattle; he fattens these cattle during the winter and in the spring sells them at a profit which more than pays the interest charge on his loan. Or it may be that the bank advances money to enable the farmer to buy land, taking a mortgage as security. From the bank, too, the merchant and the manufacturer may borrow the money which at times they need to buy goods or raw materials, or otherwise tide them over until they can realize on their merchandise or manufactures. The funds which are lent by the bank come in part from its capital and in part from the surplus money deposited with it either as a "savings account" or "on checking deposit."

A savings account may be started either at the savings department of an ordinary commercial bank or in a special bank which receives nothing but accounts of this kind. The money so deposited is supposed to be left in the bank for a long time, and most banks reserve the right to require a notice of from 30 to 60 days for the withdrawal of savings deposits. In most cases, however, a savings bank will pay the money whenever the "pass book" showing the amount deposited and withdrawn is presented. In return for the use of this money the bank pays

interest, usually two or three per cent a year. The bank often invests its savings deposits in bonds which pay five or six per cent, and the difference represents the profits of the bank.

If a person wishes to feel free to draw out his money at any time, he places it "on deposit" instead of putting it in the savings account.

When one makes such a deposit, the bank enters it in a "ledger account" bearing the name of the depositor. Suppose you have deposited \$500 in

cash with your bank; your account will show that \$500 is credited to you. The next day you buy a horse for \$200 from a man named Smith. You give him an order or "check" ordering the bank to pay him \$200 of your money. The check gives Smith authority to demand the \$200 in gold, silver, or paper money; but instead of taking the cash, he may order the bank to keep it for him.

The bank accomplishes this with-

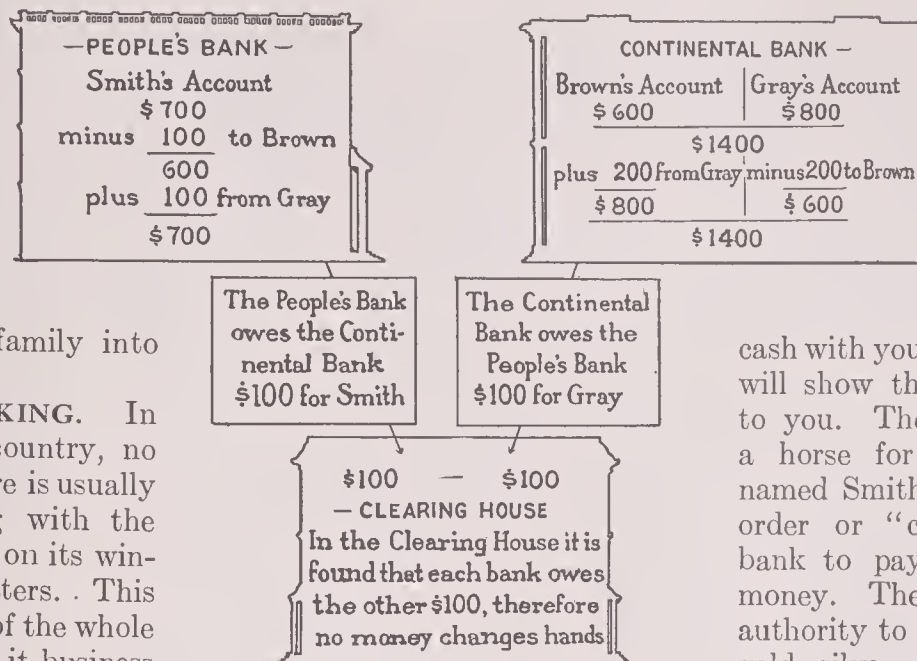
out handling any money. It merely subtracts \$200 from your account and adds that amount to Smith's. Such transactions as this, when no money changes hands, are said to be carried on by "credit," and it is in this way that nearly 90 per cent of the business of our country is transacted.

How Debts are Paid without Money

Suppose, however, that Smith wished to have another bank keep his money instead of the one in which you keep your funds. He takes your order to his bank, and by "indorsing" it, or writing his name across the back of it, he gives his bank the right to demand \$200 in money from your bank, so the \$200 is placed to his credit by his bank. During the course of the day many such orders on other banks come in to any large city bank. After banking hours these orders are collected and taken to the "clearing house," a place where representatives from all the banks of the city meet. Here they balance their accounts. For instance, Smith's bank may have \$400 in orders on your bank, while yours has \$500 on his. The account is settled by his bank giving yours a certificate or check for \$100.

But Smith's bank may be located in a small town and not a member of the clearing house in your city. In that case it sends the check to a bank in the city called its "correspondent," and this institution takes your check to the clearing house and credits the \$200 in its books to Smith's bank. For its services in collecting the city bank may charge a small fee or

HOW BANKS PAY DEBTS WITHOUT MONEY



This diagram shows you how the clearing house makes it possible for debts between banks to be paid without the use of money. Each bank, you see, offsets its debts with its claims.

"exchange." The Federal Reserve Act, passed in 1913, created a national system of clearing similar to that in use for districts, under which money can be readily and cheaply collected from any place in the country. Even if the men who are transacting business live in different countries, the banks are able, through the great banking institutions, to balance their credits so that usually it is necessary to ship but little gold across the ocean.

Why Banks Can Loan Other People's Money

From long experience in handling money, banks have learned that when funds are placed in their hands, in at least three cases out of four, the orders or checks which are drawn against these deposits are not cashed—that is, taken in currency—but are merely redeposited. A study of loans has taught bankers that if a reserve in cash of one-quarter of the amount of loans is kept on hand, they can meet all demands. A bank therefore which has \$400,000 in deposits can safely lend \$300,000 in short-time loans, if it keeps the other \$100,000 in cash on hand. The bank makes a good part of its profits from the interest it receives from the money so lent.

When a bank lends money it must take two precautions: (1) It must make its loans for a short time only—usually 30, 60, or 90 days—so as to protect the bank against a sudden increase in the demand for money; (2) it must be reasonably sure that its loans will be repaid. To satisfy itself on the latter point, banks investigate the character of the borrower and of his business. They ask of people who know him such questions as the following: What is his record for honest dealing? What are his church affiliations? Does he gamble or drink? What are his political ambitions? What is his style of living; his wife's social ambitions? Does he spend more than his income, spend all of it, or does he manage to save some? Does he possess commonsense and shrewdness? What success has he attained in his present line of business; in other lines? What is the amount of capital invested in his business and what proportion does he own? What is the condition of his business? How much insurance does he carry?

Why Good Business Men are Often in Debt

Because practically every business man needs at some time or other to borrow money, it is well to be able to show a good record in all of these lines. For this reason a bank account is a good business proposition as well as an investment for the future. If a man's previous record is good the bank will usually be willing to lend merely on his promise to repay, that is, his "promissory note," although it may also want to be secured by the deposit of "collateral," usually stocks or bonds which may be sold if the note is not paid. Usually the bank does not actually hand over the cash, but credits the amount of the loan to his account, so that he can write checks on it. This is called "lending the bank's credit."

In the United States there are three classes of banks. A *national bank* is an institution which secures its

charter, or right to carry on business, from the national government. Its business is regulated by national laws and its books are examined by officers of the federal government. The bank is not, however, run by the government, and if it should fail, its debts are not paid by the government. *State banks* secure their charters from the states in which they are located, and conduct their business in accordance with the state laws. In many states there is no law to prevent anyone from displaying a sign "bank" and taking all the deposits he can get. The safety of such a *private bank* depends entirely upon the honesty and business ability of the men at its head. It may be as good as any national bank in the country, as is the J. Pierpont Morgan institution in New York City. But since there are usually no restrictions on the way the business shall be conducted, there is an unlimited field for fraud and dishonesty.

Some of the private banks are known as "trust companies." These started as organizations which "hold in trust" the property of deceased persons for the benefit of their heirs, and do business of a similar nature. But many trust companies have now developed a general banking business also.

Since 1913 the national banks are even more carefully regulated, under what is called the Federal Reserve Act. All national banks must be, and all other banks may be, members of the federal reserve system. By this law the United States is divided into 12 federal reserve districts, and there is one federal reserve bank located in the federal reserve city of each district (see Federal Reserve Bank).

Banks that Issue Money

Practically all state and national banks are banks of issue—that is, they have the right to issue banknotes. These notes are a form of our paper money (see Money). They are promises of the bank which issues them to pay "lawful money" of the amount specified to the bearer on demand. After President Jackson destroyed the Bank of the United States in 1833, there were frequently as many as 800 or 900 different kinds of state or private banknotes in circulation, and as the banks could issue notes as they pleased, many of these notes were worth little or nothing. But after Congress established the system of national banks in the days of our Civil War, it taxed the notes of other institutions so heavily that this practically stopped the issuance of any but national banknotes. The national banks were required to deposit with the government, bonds of the United States as security for the banknotes which they issued. Now practically all the banknotes issued are those of the federal reserve banks, and as their notes are taxed they are not apt to issue more of them than the business of the country makes profitable.

The Federal Reserve Banks and the Farmer

The federal reserve banks have helped the manufacturer and merchant so much that in 1916 Congress passed the Federal Land Bank Act to aid the farmers. These land banks give the farmer the opportunity

to borrow money on easy terms on his most available commodity—his land. The regulation of the system is practically the same as that of the federal reserve banks. (See Farm Loan Board.)

The history of banking goes back to the money-changers of the medieval Italian cities who conducted their transactions from a bench on the street; and from the Italian word *banco*, referring to this bench, comes our modern term "bank." From these money-changers in Italy developed the first commercial bank, the Banco di Rialto of Venice, established in 1587. England, France, Germany, Sweden, and most other states of Europe now have great state banks which act as agents of the government in its financial affairs. Since 1910 the federal government has maintained the Postal Savings Bank as a safe place of deposit for money, paying two per cent interest on deposits. In North Dakota, under the leadership of

the Nonpartisan League, a state bank called the Bank of North Dakota has been established to receive public moneys on deposit and lend them to farmers and merchants at reasonable rates of interest.

BANYAN TREE. This remarkable tree of India and tropical Africa sends down from its branches great numbers of shoots which take root and become new trunks, so that a single tree may spread over a very large area. A specimen in the Calcutta botanical garden, about 100 years old, has a main trunk 13 feet in diameter, 230 trunks as large as oak trees, and over 3,000 smaller ones. It is said that once upon a time 7,000 people stood beneath this natural temple. The banyan often grows to a height of over 70 feet, and lives through many ages, though its original trunk may decay leaving the younger ones to support the tree. It has large heartshaped leaves and inconspicuous blossoms followed by cherry-like scarlet fruit which furnishes food for the birds and monkeys that live among its branches.

Among the Hindus the banyan is held sacred, and its bark is considered to be a great tonic. The wood is light, porous, and of no value. Scientific name, *Ficus bengalensis*.

BARBADOS (*bär-bā'dōz*). Although the self-governing British island colony of Barbados, the easternmost of the West Indies, is no larger than an average United States county, its nearly 200,000 inhabitants make it one of the most densely populated regions in the world. Its palm-shaded roads are lined almost

continuously with pink-tinted cottages or huts with roofs of ragged thatch. Many of the negro men emigrate because of the pressure of population, and so three-fifths of the inhabitants are females, who are to be seen everywhere skilfully carrying on their heads the goods they have for sale.

A TREE WITH THOUSANDS OF TRUNKS



Here truly, in this banyan forest, is a case where "you can hardly see the wood on account of the trees. One tree has so many trunks that the parent is almost lost in its own wilderness.

Negroes outnumber the whites about thirteen to one, but Barbados has solved the race problem, and there is no color line except that the races do not mix socially. Negroes have equal rights in the schools, in the churches, and in politics, and hold many important posts. Civility and good humor seem to be universal, and law and order always prevail.

England obtained the island by settlement about 1625. The colony is administered by a governor, an executive council, and a legislative council, all appointed by the British government, and a house of assembly elected by the people. The capital is Bridgetown.

Coral reefs fringe the coasts of Barbados. The surface, broken by a few forests and streams, is elevated in the interior, where Mt. Hillaby rises to 1,104 feet. Most of the island (area, 166 square miles) is under cultivation, chiefly for sugar cane, but also for cotton, coffee, and tobacco. It enjoys a healthful climate, which is especially beneficial for those with lung diseases. George Washington's only journey abroad was to take his sick brother there in 1751. Hurricanes sometimes take a fearful toll of lives and property. Barbados (the Spanish word for "bearded") probably takes its name from the bearded fig tree which grows there.

BARCELONA, SPAIN. As you wander through the streets of Barcelona—the largest city, the chief manufacturing center, and the second seaport in Spain—you find yourself in a cosmopolitan city of the modern

world. Picturesque remains of its ancient splendor are still to be seen in the "old town" with its narrow streets, medieval churches, and flat-roofed brick dwellings; but for the most part Barcelona is so different from the quaint old cities characteristic of Spain that it seems a city apart, given over to business.

Built on the sloping edge of a small plain, between the rivers Besos on the north and Llobregat on the south, Barcelona lies along the Mediterranean in the shape of a half moon. The "new town" to the north, built on a regular plan, has wide streets, handsome modern houses of hewn stone, and gardens of almost tropical luxuriance. The main thoroughfare of the "old town" is the Rambla, which has a fine promenade, with plane-trees planted down the center, and on either side the principal hotels and theaters of the city. On an oval hill at the highest point of the Rambla stands a famous 13th century cathedral, one of the finest examples of Spanish Gothic architecture.

Since early in the Christian era Barcelona has been one of the most important Mediterranean ports. Chief of its extensive industries are the spinning and weaving of cotton, silk, and woolen goods. The World War of 1914-18 gave great impetus to the city's manufactures, for many articles needed in commercial production, which had previously been imported, began to be manufactured there. Many new textile companies and tanneries sprang up, but the greatest growth was in the output of chemical products—dyes, soaps, fertilizers, drugs, etc.—formerly imported from Germany. The chief imports of the city are raw cotton, hemp, coal, grain, and foodstuffs. Fruits, wines, olive oil, textiles, leather goods, machinery, furniture, etc., are among its exports.

Barcelona is said to have been founded by the Carthaginian, Hamilcar Barca, in the 3d century B.C.; it thus acquired its ancient name *Barcino*. It became a colony under the Romans, and in the second century A.D. was the leading market on the western Mediterranean, rivaling Marseilles. It retained its importance under the Goths and the Moors, and in 801 came, with the rest of Catalonia, under Frankish rule. From the 9th to the 12th century its counts ruled it as independent sovereigns. It reached the zenith of its fame in the 12th century, when its merchant ships vied with those of Genoa and Venice, trading as far west as the North Sea and the Baltic, and as far east as Alexandria. But in the early 16th century much of its importance was transferred to ports of western Spain, because of the trade that sprang up with America. In the 17th, 18th, and 19th centuries it came several times under French rule.

As a result of its large industrial population, the city has long been noted for the frequency and violence of its labor disputes, and has been considered a hot-bed of anarchism and other radical propaganda. Population, about 622,000.

BARK. Why do we wear clothes, and why do birds wear feathers and fishes scales? For much the same reason that a tree is clothed in bark, only bark is for protection rather than for warmth.

Each species of trees wears a characteristic outside garment so that if we were wise enough we should know the name of the tree by a glance at its bark.

Between the inner bark and the body of the tree is a wonder-working layer of vital cells called the "cambium" that acts like a fairy godmother to the trees. The cambium builds cells on the *inside* that form the year's ring of new wood on the trunk and branches; and on the *outside* it builds layers of cells which make the bark. At first these bark cells are soft and full of living material; but later they collapse, and the busy cambium builds another and another layer of cells inside them, thus pushing them out until they become dry, hard, and inelastic. Since the cambium is always building layers on the trunk of the tree to make it larger around, the pressure of this growth causes the bark to split into ridges, scales, or strips, since it is too dry to stretch. The bark protects the tree in many ways, especially from the attacks of fungi, and it should never be bruised or hacked off, thus leaving the wood exposed.

The bark of many kinds of trees is of great commercial importance, that of oak and hemlock being used for tanning leather. Very important medicines and dyestuffs are made from bark. Quinine, for example, is made from the bark of the cinchona tree, and cascara, which is widely used as a laxative, comes from the bark of the California buckthorn. Stick cinnamon is the rolled inner bark of a small East Indian tree, used as a spice, and cork is the rough outer bark of a species of oak. Almost every boy has learned how to remove the bark on willow twigs by pounding, to make a whistle. The Indians made strong light canoes of the bark of certain birches, and from the pliable fibers of certain other barks savage tribes make rude cloths for rugs and clothing.

BARLEY. The most ancient food of mankind, according to the historian Pliny, was barley, our fourth most important grain. Barley has been found in the excavated lake-dwellings of Switzerland belonging to the Stone Age. Chinese sacred books claim that it was known in China 20 centuries before the birth of Christ, and the ancient Hebrews used the grain while they were in Egypt, for it is referred to in Exodus.

In appearance barley is not unlike wheat, but it will grow in climates too cold for the latter grain. It is cultivated from the arctic region of Alaska to tropical India, and it grows wild in western Asia. As it takes a shorter time for barley to ripen than for wheat, it is usually sown in the spring after the wheat, and is harvested before the wheat is ripe. It needs a light well-drained soil, and as the roots are short the ground does not require deep plowing.

There are three well-known kinds of barley: the two-rowed, the four-rowed, and the six-rowed. The difference is in the number of rows of grain in the head and in the long beards or spikelets on each head. In the two-rowed variety only two rows of the spikes produce grains. In the four-rowed variety, four rows of the spikes are fertile; and in the six-rowed, each

spikelet produces a grain of barley. The two-rowed type is most common in Europe, while in this country the six-rowed kind predominates. As the four-rowed species is a poorer quality, it is raised only in the

VARIETIES OF BARLEY



In this picture A and B are six-rowed varieties. A is a commonly grown form in which the two outer rows dovetail together so that they look like a single row. Figure B represents the true six-row, or club, barley. Two-rowed varieties are shown at C and D. C has the "awns," or beard removed. D is a slender variety with "awns" still attached.

northern latitudes, to which it is better adapted than the others, as it is extremely hardy.

Barley is not used as a food so much as are other grains, for it has little gluten in it. Still, thousands of peasants in Europe eat the black barley bread. The round grains, called pearl barley, and the patent barley flour are used for thickening soups, for making gruel for invalids, and for modifying cow's milk for babies. The chief use of barley, however, is in the preparation of malt for beer and malted foods (see Malt).

Scientific name of two-rowed barley, *Hordeum sativum distichum*; of four-rowed, *Hordeum sativum vulgare*; of six-rowed, *Hordeum sativum hexastichum*.

BARNACLE. Individually barnacles are helpless little animals, not much bigger than your thumb; but collectively they can materially lessen the speed of a huge ocean liner.

The common ship barnacle starts out in life independent, active, and able to swim about alone. But

soon it gets tired and fastens upon any support it can find—a rock, or a floating log, or a wooden pile under a pier. There it develops a limelike shell with a movable lid. It likes ship bottoms best of all, however, because they provide it with excitement. Thus barnacles gather beneath the water line of vessels in such immense numbers that they produce a tremendous "drag" which slows down the craft. Ships have to be lifted out of the water from time to time to have their bottoms scraped free of these salt-water pests.

Another kind of barnacle, sometimes called the "acorn-shell," prefers to live on rocks. These may be found in large numbers at low tide, withdrawn into their small houses, waiting for the return of the water which brings them their dinner.

It was believed at one time that barnacles were mollusks, like clams or oysters, but it turned out that they are crustaceans—degenerate relatives of the lobster and the crab. Born free, they start on the down-

LITTLE SAILORS ON A CORK



This group of barnacles was found attached to a cork floating in the currents of the sea. You can see how a coating like this all over a ship's bottom would be such a drag that the ship would have to go into dry-dock to have the little pests scraped off.

ward path as soon as they attach themselves to some object. They develop a hard shell and lose their power of motion, except in the six pairs of feathery feet which project from the shell and wave food into their mouths. At the base of the barnacle's shell is a cement gland which provides the powerful "sticking" qualities needed by the creature.

Scientific name of ship barnacle, *Lepas anatifera*; acorn-shell barnacle, *Balanus tintinnabulum*.

HOW BAROMETERS MEASURE MOUNTAIN HEIGHTS



Haven't you often wondered how men learn the height of mountains? You know you couldn't measure straight down through a mountain! This picture shows one way in which it is done. The height of a mountain means its height above sea level. Now at sea level the barometer stands at 29.9 inches, but as the instrument is carried up higher and higher, the air pressure becomes less and less until, when you have reached three miles, say, it stands at 15 inches. The diagram on the right shows the principle of the barometer. The pressure of the air forces the mercury in the bowl up into the vacuum tube, until the weight of the column of mercury exactly balances that pressure, just as the pound of sugar the grocer puts into the scales balances the pound weight.

For any subject not found in its alphabetical place see information

BAROMETER. One day near the middle of the 17th century a German scientist, the mayor of Magdeburg, Otto von Guericke, who was always trying new and strange experiments, astonished his neighbors by erecting on the wall of his house a strange looking tube. The tube was something more than 34 feet long, and was made of brass except the top section, which was of glass. It was closed at the top. The lower end of the tube dipped in a basin of water, and the water was seen to rise in the tube to a height of about 30 feet. The top of this column of water was seen through the glass and on it floated a quaint wooden manikin. "Von Guericke's little weather man," the people called it, for they saw that it rose higher in fair weather and went down in stormy weather. The neighbors thought it all a work of magic, but, as von Guericke's book tells us, it was really a water barometer.

Only a few years before Guericke was trying this interesting experiment, Torricelli, an Italian scholar who was a pupil of the famous Galileo, invented the mercury barometer, the form of the instrument now commonly in use.

The barometer is an instrument for measuring the pressure of the air of the atmosphere. Mercury and not water is chosen because the greater weight of mercury reduces the length of the tube required to 36 inches. To make a simple barometer, you take a glass tube of this length, closed at one end, and fill it with mercury. You then invert the tube, keeping the finger over the open end, and place the open end in a vessel of mercury. When the finger is removed, only a little of the mercury will run out of the tube into the vessel, for the pressure of the air upon the surface of the mercury in the vessel supports the weight of the column of mercury. The space in the tube above the column of mercury is nearly a perfect vacuum, so there is no pressure on top of the column. The mercury column in the tube remains about 30 inches high, and this means an air pressure of about 14.7 pounds to the square inch. By a graduated scale generally attached to the glass tube, we can measure the fluctuations in the height of the mercury resulting from changes in the air pressure.

The air pressure varies in part with changes in weather conditions, and this makes the barometer of great importance in forecasting the weather (see Weather Bureau). Experience has shown that sudden decrease of pressure, that is, a "falling barometer," indicates the approach of a storm. Increasing pressure—a "rising barometer"—is a sign of fair weather. A steady "high barometer" denotes settled fair weather.

The height of the barometer column also varies with the altitude. Thus when a barometer is carried to the top of a high tower, or up a mountain, the mercury falls lower and lower, because the air pressure decreases with the altitude. By comparing the reading at sea-level with readings at other levels, the altitude of any place can be readily calculated. Corrections

of course must be made for weather conditions.

The mercury barometer is a fragile and awkward instrument to carry, so for portable use engineers and explorers generally use the *aneroid* barometer. This is also the instrument used in airplanes and balloons to determine altitudes. The aneroid consists of a closed metal box with an elastic flexible top, and it is arranged so that a pointer indicates even slight changes of pressure of the outside air on the top. Aneroids have to be graduated by comparison with a mercury barometer.

BAR'RIE, SIR JAMES MATTHEW (1860-). A small man with a great heart, one of the shyest and most retiring persons, though his writings have brought the world to his feet, a man of insight and wisdom who has still kept the freshness and gaiety of childhood, a man of tenderness, kindly humor, playful wit, and whimsical fancy—this is J. M. Barrie.

His birthplace was the little Scotch village of Kirriemuir, described in his writings under the name of "Thrums." There in the garret of his simple home he began to write stories of adventure before he was 12. One of his chief tasks as a small lad—and for long afterward—was to cheer his mother when she was ill. In trying to make her laugh he developed that gift of humor, touched always with pathos, which is his greatest charm. From his mother, so he tells us in his beautiful story of her life, 'Margaret Ogilvy', he learned all that he put into his books, and under many names and with many changes of feature she appears as the heroine in almost every one of Barrie's writings. From this charming Scotswoman Barrie inherited that whimsically sunny view of life which age or sorrow could not take from her.

After being educated at Dumfries Academy and Edinburgh University, Barrie became a journalist, contributing to various English papers. He first won recognition by his stories of his native village, 'Auld Licht Idylls' and 'A Window in Thrums'. His first long novel, 'The Little Minister', appeared in 1891 and was followed by two other successful novels, 'Sentimental Tommy' and its sequel, 'Tommy and Grizel'. Later he turned to the theater and produced a number of charming dramas, several of which—such as 'Quality Street', 'What Every Woman Knows', 'The Legend of Leonora', 'Peter Pan', and 'A Kiss for Cinderella'—have been delightfully interpreted on the American stage by Maude Adams. The beautiful fairy play 'Peter Pan' won for Barrie the title of "the Hans Christian Andersen of the stage."

Barrie's chief works are as follows: 'Auld Licht Idylls' (1888); 'A Window in Thrums' (1889); 'My Lady Nicotine' (1890); 'The Little Minister' (1891); 'The Professor's Love Story' (1895); 'Sentimental Tommy', 'Margaret Ogilvy' (1896); 'Tommy and Grizel' (1900); 'The Little White Bird' (1902); 'Quality Street', 'The Admirable Crichton', 'Little Mary' (1903); 'Peter Pan' (1904); 'Alice Sit-by-the-Fire' (1905); 'What Every Woman Knows' (1908); 'Peter and Wendy' (1911); 'The Legend of Leonora' (1913); 'Der Tag' (1914); 'A Kiss for Cinderella' (1916); 'The Old Lady Shows Her Medals', 'A Well-Remembered Voice', 'Dear Brutus' (1917).

PETER PAN TO THE RESCUE!



"On the pirate ship Captain Hook had just dragged up his prisoners from the hold and was going to make them walk the plank. But all of a sudden the pirate heard something that changed his look of glee to one of terror. 'Tick! Tick! Tick! Tick!' 'The crocodile!' he cried. 'Hide me!' It was Peter Pan coming to the aid of his comrades. The clever boy had imitated the ticking of the crocodile. The wicked Captain Hook found himself at the mercy of his enemy."

For any subject not found in its alphabetical place see information

The BOY WHO WOULD NEVER GROW UP



The STORY of PETER PAN

ONCE upon a time there lived three little children named Wendy Moira Angela, John Napoleon, and Michael. Their parents were Mr. and Mrs. Darling; their nurse—strange as it may seem—was a big Newfoundland dog.

Mrs. Darling was glad to have this big brave dog to watch over the children, for one night something happened which made her feel very uneasy. She woke up suddenly and saw a strange figure, no bigger than a little boy, standing just inside the nursery window. Nana growled and sprang at the little boy, and he leaped lightly through the window. But he lost his shadow, for the good dog shut the window down so quickly that the shadow was snapped off. Mrs. Darling took the shadow, rolled it up carefully, and put it in a drawer. Nana was a great treasure, she thought. But one night when Mr. Darling was rather out of sorts, he said that it was ridiculous to keep a dog as nurse, and he dragged Nana off to her kennel in the yard.

That very night, after Mr. and Mrs. Darling had gone out, Peter Pan—for he was the mysterious little boy—came back to look for his shadow. A bright spot of light darted before him, flitting about to every corner of the room, and making a tinkle as of golden bells. When it was still for a moment one could see that the light was really a little fairy girl. The tinkling sound was her way of speaking, and she was called Tinker Bell. She

stopped at the chest of drawers and told Peter that his shadow was there. The boy ran to it and snatched out the shadow. But to his dismay, when he tried to put it on, it wouldn't stick to him. At last giving up in despair, he burst into tears.

His sobs woke Wendy. She sat up in bed and asked him his name and why he was crying. She knew at once what to do. She got a needle and thread and sewed on his shadow. Peter Pan strutted up and down with a cocky air, and danced about in wild glee, watching his shadow follow him as he moved.

"How old are you, Peter?" queried Wendy.

"I don't know," he replied, "but I am quite young. I ran away the day I was born."

"Ran away? Why?"

"Because I heard my father and mother talking about what I was to be when I became a man. I don't want ever to be a man. I want always to be a little boy and have fun. So I ran away to live among the fairies."

"Peter, do you really know fairies?" asked Wendy, wonderingly.

"Yes, but they're nearly all dead now. You see, when the first baby laughed, its laughter broke into a thousand pieces and each piece went skipping about, and that was the begin-

ning of fairies. And now, whenever a new baby is born, its first laugh becomes a fairy. But whenever a child says it does not believe in fairies, then one of the fairies dies."

Then Peter told Wendy that he lived in a place called Neverland, with the lost boys who had fallen out of their baby carriages when their nurses were looking the other way. He was their captain and



"Their nurse—strange as it may seem—was a big Newfoundland dog."

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they had great fun. There was just one thing they lacked—that was a mother to tuck them in at night and tell them stories.

"Oh, Wendy," he cried, "won't you come and live with us and be our mother?"

Wendy hesitated when she thought of her own mother, but Peter won her by telling her of the wonders of Neverland, and by promising that he would teach her and John and Michael to fly. And so the two boys were awakened, and after Peter had sprinkled them with fairy dust, they were able to fly far away through the depths of the starry night to the Neverland.

Now the lost boys, who had been anxiously awaiting Peter's return, were much surprised to see what appeared to be a lovely white bird flying toward them. While they were gazing at it, the fairy Tinker Bell approached, tinkling very loudly. She was telling them that Peter wanted them to shoot the bird at once. One of the boys fired at the bird. It fell to the ground, and then they saw it was not a bird at all, but a little girl. It was Wendy, who had come to be their mother. Tinker Bell had told them to do this dreadful thing because she loved Peter and was jealous of Wendy.

But Wendy was not dead; she had only fainted. She soon revived, but still lay on the ground very weak and tired. The boys built around her a tiny house—

The littlest ever seen
With funny little red walls
And roof of mossy green.

They stuck on John's tall hat for a chimney, and soon the smoke was rising cosily.

Peter and Wendy and their little family were very happy together. Every night Wendy went to the underground home, down among the roots of the trees, where the boys lived. She told them stories and tucked them into their great bed before she went to her own little house. They had some very thrilling adventures, too, for there were wolves and pirates and Indians, as well as fairies in Neverland.

The Pirate and the Crocodile that Ticked

Captain Hook was the wickedest and fiercest of pirates. On his right arm, instead of a hand, he had an iron-pronged hook, and that is how he got his name. Some time before, in an encounter between the pirates and the lost boys, Peter had cut off his right arm and flung it to a passing crocodile. The crocodile had liked the taste of it so much that ever since he had wandered from land to land and from sea to sea licking his jaws for the rest of the captain.

But fortunately for Hook, the crocodile had swallowed an alarm clock. This clock ticked so loudly that it could be heard through the crocodile's skin, and so the pirate captain could always hear it coming. But Hook lived in terror lest the clock should run down and the crocodile come up and swallow him before he heard a sound.

No wonder Captain Hook hated Peter Pan, who

was the cause of all his troubles. But so far he and the boys, aided by the Indians, who were their friends, had escaped the clutches of the pirates.

One evening while the faithful Indians were keeping guard without, Wendy, as usual, was telling the boys a story before tucking them into bed. This time the story was about her own father and mother and the children who had flown away. She told them how lonely and sad Mr. and Mrs. Darling must be, and how they would always keep the nursery window open in case the children should come flying home.

Then Poor Little Peter Groaned!

But when she had finished, Peter gave a groan. He felt that he must tell the truth. "Long ago," he said, "I thought like you that my mother would always keep the window open for me, so I stayed away for moons and moons and moons, and then flew back; but the window was barred, for mother had forgotten all about me, and there was another little boy sleeping in my bed."

Perhaps it was not true, but Peter thought it was, and it scared the children.

"John! Michael!" cried Wendy, "we must go back at once."

The lost boys begged her not to leave them. Peter wanted her most of all, but he refused to show his feelings.

Then Wendy suggested that the boys all come too. She felt sure that her mother and father would be glad to adopt them. The boys were delighted with the idea of having a real father and mother—all except Peter Pan. Though his heart ached at the thought of losing Wendy, he wouldn't consent to live in a real house and grow up like ordinary boys.

The last thing the little mother did before leaving was to pour out Peter's medicine and make him promise to take it. And so they said good-by to Peter Pan.

But now a terrible thing happened. The pirates had driven away the Indians and were lying in wait for the children. They pounced upon them as soon as they came out, and carried them prisoners to the pirate ship.

Hook, annoyed at not finding Peter among them, went to the cave in search of him. Poor Peter, after a forlorn attempt to prove to himself that he was not lonely, had at last fallen asleep. Thus Hook found his old enemy defenseless. When he caught sight of Peter's medicine standing on a ledge within easy reach, a terrible red light came into his eye. He poured into it a few drops of deadly poison and stole away.

"Don't Drink! Don't Drink!" Cried Tinker Bell

Peter awoke and was just about to take his medicine, when he heard a tinkling voice, "Don't drink! Don't drink!" It was Tinker Bell speaking.

"Don't be silly," said Peter, and he raised the glass to his lips. But just as he was about to drain it, he saw a shining light in the glass. Then he knew

that Tinker Bell had drunk the poison to save him. She was dying. There was just one way to save her.

"Do you believe in fairies?" he cried to all the children in the world. "If you believe, clap your hands and save Tinker Bell."

There was a clapping of many hands, and Tinker Bell revived. She told Peter about Wendy and the boys, and immediately Peter set off to rescue them, swearing this terrible oath, "Hook or me this time!"

On the pirate ship Captain Hook had just dragged up his prisoners from the hold, and was going to make them walk the plank. But all of a sudden the pirate heard something that changed his look of glee to one of terror. "Tick! Tick! Tick! Tick!"

"The crocodile!" he cried. "Hide me!"

The terrified crew gathered around their captain. The boys looked toward the ship's side, expecting to see the crocodile climbing over it. But instead of a crocodile, they saw—Peter, coming to their aid. The clever boy had imitated the ticking of the crocodile.

The Terrible Fight that Peter Won

There was a terrible fight between the pirates and Peter's band. Some of the pirates, panic-stricken, jumped overboard. The rest of the crew were cut down. The wicked Captain Hook found himself at the mercy of his old enemy Peter Pan. Step by step Peter forced the pirate chief to the side of the ship, till Hook in desperation thought some fiend was fighting him.

"Pan, who are you?" he cried huskily.

"I'm youth—eternal youth!" cried Peter exultantly. "I'm the sun rising—I'm poets singing—I'm the new world—I'm a little bird that has broken out of his egg—I'm joy, joy, joy!"

With that he wrenched the sword out of Hook's hand, and pushed him overboard, right into the open jaws of the waiting crocodile.

Peter was now in command of the ship, and the children sailed homeward. Their home had been a very sad place while they were away. Mr. Darling, to punish himself for taking away the children's nurse, had insisted upon sleeping in Nana's kennel. Mrs. Darling had thought of them day and night, and always left the window open.

And now at last the children were enfolded in their dear mother's arms. Peter watched them wistfully

from outside the window. He had many joys unknown to ordinary children, but this happiness was not for him. Mrs. Darling wanted to adopt him along with the other boys. But no. Peter wanted very much to have a mother, and he loved Wendy dearly, but he couldn't bear the thought of growing

WENDY SEWING ON PETER'S SHADOW



"His sobs woke Wendy. She sat up in bed and asked him his name and why he was crying. She knew at once what to do. She got a needle and thread and sewed on his shadow. Peter Pan strutted up and down with a cocky air and danced about in wild glee, watching his shadow follow him as he moved."

up. Wendy's mother was so moved at the thought of Peter living all alone that she offered to let Wendy go to him for a week every year to do his spring cleaning.

As the years went on the children all grew up and became men and women; but not Peter. High up in the tree-tops in Neverland, the fairies placed the little house that had been built for Wendy, and there Peter Pan lives on and on and on, with Tinker Bell.

BARTON, CLARA (1821-1912). Although she grew up to be one of the bravest and most capable women that ever lived, Clara Barton, the founder of the American Red Cross, was painfully timid and bashful as a little girl. Born and brought up on a farm near Oxford, Mass., she was fond of all outdoor sports and could ride any horse, but she was afraid to meet strangers, afraid to recite in school, afraid of herself. Only in thinking of others who were in pain and

distress did she forget about herself and become so fearless that even the battlefield had no terrors for her. About 50 years of her life were spent amid scenes of suffering and death.

As a teacher, although her shyness almost got the better of her the first day, she won her pupils through her love and sympathy and became very successful. Later she proved her executive ability as a clerk in the United States Patent Office, where she was the first woman to be placed in charge of a department.

When still a mere child, Miss Barton had nursed an elder brother back to health after a serious accident, and through this experience she had learned much about the art of nursing. At the outbreak of the Civil War she volunteered for hospital service, and soon this gentle, timid little woman was caring for the wounded soldiers, close behind the firing line, where she won the title of "The Angel of the Battlefield." After the war she searched hospitals, prisons, and battlefields for missing soldiers, carrying on this work at her own expense until she received an appointment from President Lincoln.

In 1869 Miss Barton went to Europe for a much needed rest; but when the Franco-Prussian War broke out, in the following year, she at once gave her services in relief work. Through her efforts the American Red Cross was organized in 1881, and she became its first president (*see* Red Cross). From that time until she retired in 1904, wherever fire, flood, earthquake, pestilence brought suffering to be relieved, her activity was unremitting. She also wrote a history of the Red Cross, and other works.

"I have no mission," she once said. "I have never had a mission. But I have always had more work than I could do lying around my feet and I try hard to get it out of the way so as to go on and do the next."

BASEBALL. Someone has said that America and baseball met each other when they were young and grew up together. The ancestor of the game was the old English "rounders," which to the early American settlers was known as "town ball." Modern baseball originated with the old Knickerbocker Club of New York City, which published the first rule book in 1845. From that time the game, while undergoing many changes, steadily increased its hold upon the boys and men of America.

When the Civil War broke out, the game became a favorite camp pastime, and was played by the soldiers in gray as well as by the boys in blue. At the close of the war it was carried by returning soldiers to every section of the country, north and south. Thus it may be said with accuracy that baseball as

the national sport of the United States dates from the Civil War.

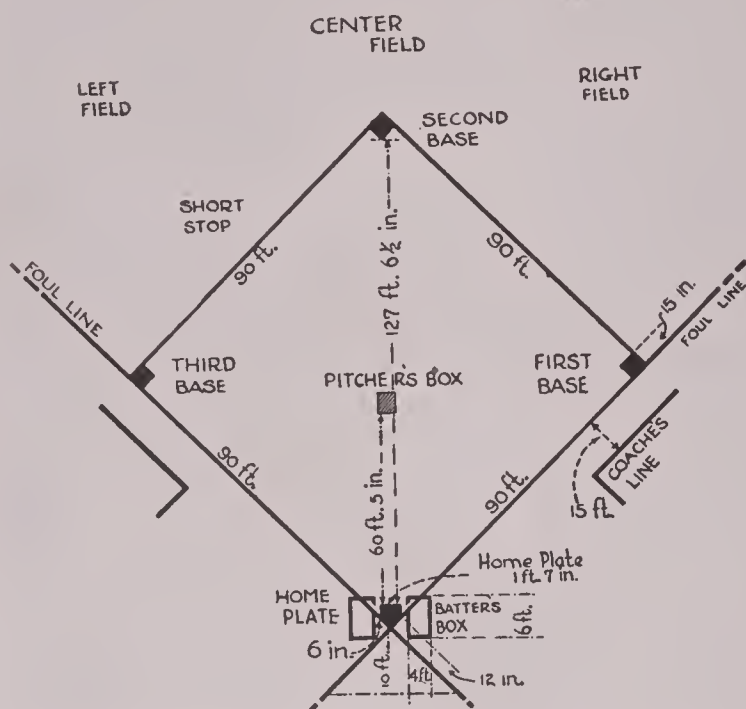
Amateur and professional clubs sprang up in the 70's and 80's with ever-increasing rapidity. In 1871 the National League was formed, and in 1900 the American League. In addition to these two "major" professional leagues there are a number of "minor" leagues scattered throughout the country. Following the competition which results in the winning of the two league championships, there is a "world series" in which the winner in each league competes for the championship honors of the world.

The immense crowds that attend these struggles attest the popularity of America's national game. It is not at all uncommon for 40,000 persons to witness one of these games. Players and spectators are keyed to the highest pitch of excitement and rivalry, yet it is rarely that any unsportsmanlike incident occurs. Baseball is a clean sport and it is greatly to the credit of the men who have built up the professional game that the play in the leagues is so largely free from rowdyism and unfair tactics.

Now, Watch This Game

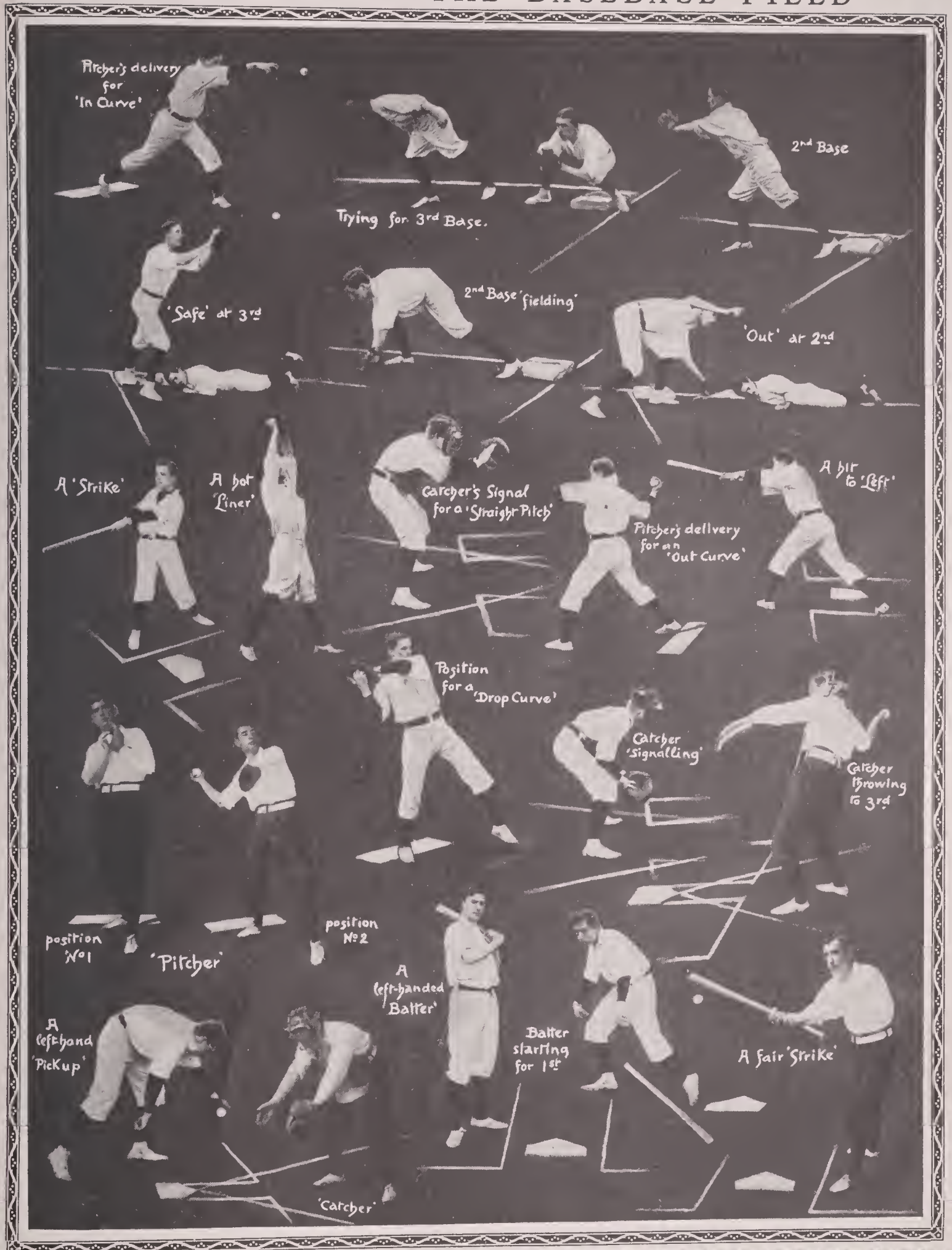
The baseball field is laid out in the form of a diamond 90 feet on each side, with bases at each of three corners and the "pitcher's box" 60 feet 5 inches from the "home plate" (or fourth base), on a line between home plate and second base (*see* diagram). At the start of the game the nine players who compose one of the teams take their positions on the field, while the other team, in fixed succession, come to bat. In the early days the ball weighed 6½ ounces and measured 10½ inches around, but today the official ball weighs 5 ounces and is 9 inches in circumference. At first the rules obliged the pitcher to "pitch" the ball from below the shoulder level, but now he may "deliver" almost any sort of a ball (pitched or thrown, swift or slow, incurve, outcurve, drop, "fade-away," etc.), provided he remains in his position and does not commit a "balk" or feint. Each time the batter swings at the ball and fails to

DIAGRAM OF A BASEBALL FIELD



This diagram shows just how a baseball field is laid out and why it is called a "diamond." You are standing back of the home plate and looking out towards center field.

SNAPSHOTS ON THE BASEBALL FIELD



It is almost as good as going to a ball game to study this group of pictures. First comes the center of interest in every game, the pitcher. The first picture shows how the "in" curve is thrown; others in the third and fourth rows show the "out" curve and the "drop" curve. The catcher indicates by signals the sort of ball he wants the pitcher to throw. In spite of their tricks the runner in the second picture has made second base and is trying for third. In the beginning of the second row we may suppose he has safely reached it, while the unfortunate to the right is "out" at second. Other pictures show various additional features of the thrilling American national game.

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hit it, a "strike" is counted against him. Three of these strikes put him out and he retires to the bench while another player of his team takes his place. When the pitcher throws the ball across the home plate not lower than the batter's knee or higher than his shoulder and the batter makes no attempt to hit it, the umpire, who stands behind the pitcher or the catcher, calls a "strike." If the pitcher misses the plate, or throws above the batter's shoulder or below his knee, the umpire calls a "ball." Four "balls" give the batter a "pass" to first base.

The batter's object usually is to make a fair hit—a ball batted within the lines that run from home to first base and home to third and beyond. A "bunt" is a short hit into the infield without swinging at the ball; a sacrifice hit is a hit which puts the batsman out but advances a runner on bases. All other hits are fouls; they count as strikes except on the third strike, in which case they are not counted. If the fielders fail to catch a fair ball before it touches the ground, or fail to throw it to the first baseman before the batter reaches first base, he is "safe."

He may continue on to second, third, and home so long as he is not touched while between bases by the ball in the hand of one of the fielders, or hit by a batted ball, or "forced out" at one of the bases.

How a Batter is Put Out

If the fielders succeed in catching a fair or a foul hit before it touches the ground, the batter is out. He is also out if they succeed in fielding a fair hit to the first baseman before the batter reaches first base. If a player crosses the home plate without being put out, he scores a run; if he makes the complete circuit of the bases on a single hit it is a "home run."

The team at bat continues to play until three of its men have been put out. It then exchanges places with the team in the field which now takes its turn at bat. The "inning" ends when each side has had three outs scored against it. Nine innings constitute

a game, except in the case of a tie score, when the game continues until one side or the other at the close of an inning retains a lead.

Why the Pitcher is Such a Great Man

The most important man on the team is the pitcher. His ability to strike out the opposing batters or to compel them to hit the ball into the hands of the fielders is of tremendous advantage to his team. A good pitcher is able to puzzle batters in many ways. For example, he may be clever at changing pace, throwing first a swift ball and then a slow one, or vice versa, with identically the same apparent motion, in order to prevent the batter from timing his swing effectively. A big league pitcher sends the leather-covered sphere across the plate with startling swiftness and remarkable accuracy. His whole act of throwing is done in such a way as to put every ounce of his body into the pitch. To the person who is ignorant of the long years of practice that he has spent in developing this ability, his skill seems marvelous.

His Marvelous Curves!

The most wonderful thing he does is to throw a ball that curves up or down or in or out at his will. The whole trick lies in the spinning motion he gives the ball as it leaves his hand. An outcurve is one that breaks to the catcher's right and the spinning motion is in the same direction, that is, from left to right. There are several ways of delivering the ball to do this. The common one is to grasp the ball between the two front fingers and the thumb and as the throwing arm comes to the front the wrist is turned to bring the palm up and the ball is released sharply between the first finger and the thumb. The same hold with a slight shift in the position of the wrist and of releasing the ball will give a different spin and a different curve. The theory is that the greater pressure of the resisting air on the side towards which the ball is rotating forces it from a straight course.

THIS IS HOW YOU READ A BOX SCORE

CHICAGO							
	AB	R	BH	PO	A	E	
Leibold, rf.....	5	0	2	2	0	0	
E. Collins, 2b.....	5	0	1	1	4	0	
Weaver, 3b.....	5	0	0	1	5	0	
Jackson, lf.....	5	2	2	2	0	0	
Felsh, cf.....	4	2	2	1	1	0	
J. Collins, 1b.....	4	2	2	14	0	0	
Risberg, ss.....	5	0	1	1	3	0	
Schalk, c.....	4	1	2	4	0	0	
Kerr, p.....	3	1	0	1	4	0	
Totals.....	40	8	12	27	17	0	

NEW YORK							
	AB	R	BH	PO	A	E	
Peckinpaugh, ss.....	4	2	2	0	2	1	
Pipp, 1b.....	3	1	1	12	1	0	
Pratt, 2b.....	4	0	1	1	3	1	
Ruth, lf.....	3	2	2	3	0	0	
Meusel, rf.....	4	0	1	2	0	0	
Bodie, cf.....	4	0	2	2	0	0	
Ward, 3b.....	4	0	1	2	5	0	
Hannah, c.....	3	0	0	4	1	2	
Thormahlen, p.....	2	0	0	0	1	0	
Shore, p.....	0	0	0	0	1	0	
*Lewis.....	1	0	0	0	0	0	
McGraw, p.....	0	0	0	1	0	0	
Totals.....	32	5	10	27	14	4	

*Batted for Shore in eighth.

Chicago.....	0	1	0	0	0	0	3	4	0—8
New York.....	0	0	0	2	0	1	0	1	1—5

To save space newspapers print the results of baseball games in the form of compact tables, which contain almost as much information as could be given in a column of description. The "box score" above summarizes the plays in a game between Chicago (White Sox) and New York. The meanings of the abbreviations after the names of the players are as follows: cf., center field; lf., left field; 3, third base; 2, second base; 1, first base; rf., right field; ss., short stop; c., catcher; and p., pitcher. The abbreviations at the head of the column of figures stand for: ab., at bat; r., run; bh., base hits; po., put-outs; a., assists; e., errors. Ruth, for example, was at bat 3 times. He made 2 runs, 2 base hits, 3 put-outs, no assists, and no errors. The score by innings shows that New York, in the fourth inning, made 2 runs and that Chicago, in the seventh, made 3 and in the eighth made 4, the final score being 8 to 5 in favor of Chicago. This particular score is especially striking as Ruth's two hits were both home runs, making his total home runs 31 in midseason and breaking his record for the whole previous season.

The next important man on the team is the catcher, who usually acts as the "general" of the nine. He stands behind the home plate, encased in his mask, chest protector, and shin guards, and with a heavily padded glove on one hand receives the bullet-like pitches of his teammate. He has many opportunities to save the game for his team. But for that matter every member of the nine, by good hitting or clever fielding, may play an important part in the winning of a victory. Each team has an elaborate system of signals for the batter and runners, meaning "Hit it out," "Wait," "Steal base," "Bunt or sacrifice," and the like.

The game of baseball as developed to its highest perfection in the professional leagues and in the colleges calls for physical alertness, speed, skill, good eyesight, courage, and ability to think quickly. No game is exactly like another, and it often happens that baseball strategy or "inside play," as it is known, wins the contest at the crucial moment. The game is almost as popular in Canada as in the United States, and it is spreading in Australia, the Philippines, and Japan. Chinese players have become quite expert at baseball.

The A B C of Good Ball Playing

Every boy wants to be a ball player and a good one. Very well. Practice will do it. Play ball and play it often. But begin early to think what you are doing and to improve in the four things that, if you excel in them, will help you make the team. The four things are batting, catching, throwing, and running the bases.

A good batter, a steady consistent hitter, will make any team. Learn to bat. Select a bat you can swing with your wrists and forearms. Don't try to "slug" the ball with all your might but learn to meet it squarely with a sharp short swing that you get your body weight behind. This means that you must never pull away from the plate by drawing back the foot nearest the pitcher. Hold that foot still at any cost. Watch the ball. Don't try too much to guess what the pitcher will throw—fast, slow, or curve. You may out-guess him, but a trained eye and quick decision are better than a few lucky hits.

Never allow yourself to begin batting overhanded, with the outside hand above the one on the catcher's side. Try standing on the other side of the plate if you cannot correct this any other way.

Practice "bunting" with a loose grip and no swing. But bunt only when the runners on bases know your plan by a signal, or when the opposing infield is playing back and looking for a swift hit. Send the ball to the ground on a bunt. What is called a "pop fly," may be fatal.

Have confidence. Just know you are going to hit even if you have two strikes.

Catching a fly or picking up a grounder right comes only with practice. Be poised to start as soon as the ball is hit. See that your hands give way so the fly ball will not jump out. Don't scoop up a grounder

with a motion against the ball. Ease back with a motion that brings you in a position to throw without loss of time. If you are an infielder or catcher, practice a snap throw that will not oblige you to draw your arm back of the shoulder in a long swing. Get in front of the ball with your heels together if you can. Don't throw wildly just to get rid of the ball. Go after every ball and never mind errors. You can't be a sign post and a good fielder at the same time.

Secret of the Pitcher's Art

Throwing, including pitching, is first of all control—ability to throw where you want to. If you want to be a pitcher, get control and leave curves and speed to follow. Practice with a batter or a post so you can throw to the shoulders, knees, waist, to the inside or outside corners of the plate, as you choose. Develop an easy shoulder swing that gets your weight behind the throw and work until you have the same motion for all curves and speeds.

As a fielder, think where you should throw the ball before any batted ball has been hit to you. In general this is to first base or always to the base ahead of the foremost runner, who will be forced by the batter to move up. If an outfielder, don't try to throw to the catcher on the fly. It may go over his head and cost the game. A throw that reaches him on the bound is safer and quicker.

Running the bases, ability to "steal a base," is as much quick starting and skillful sliding as it is speed. Practice both, especially a feet-first slide that enables you to hook the bag and get away from or under the baseman with the ball. Know whether the next base is occupied before you start to steal. Don't run blindly on a fly hit unless two are out. Otherwise move down the base line so you can go ahead or back depending on whether or not the ball is caught. Know at all times where the ball is and keep awake and on your toes and listen to the coach.

Above all, play the game fairly and squarely and never give up. Obey the coach and the captain. Don't wrangle with the umpire or play to the galleries. Every place on the team is important and to play well the part assigned you is the main thing.

Team play, "inside" baseball, and signals—the whole strategy of the game is too complex to explain here, but help can be obtained from various manuals or from an experienced coach.

BASKET. Who were the first basket-makers? Probably the birds, whose instinct taught them to weave into cozy nests the materials which nature gave them. Men have learned from them or may have been led by the same instinct to intertwine branches and twigs, stems and rushes, the flexible inner bark of trees, and tough grasses. At any rate they first used basketry, like the birds, to build their homes, for rude huts fashioned in this way were among the earliest forms of shelter. Then later, but still so long ago that we have no idea how far back in the dim and distant past it was, they learned to weave these

EXAMPLES OF THE APACHE'S ART



materials into useful and beautiful vessels for storing and carrying food, and for many other purposes.

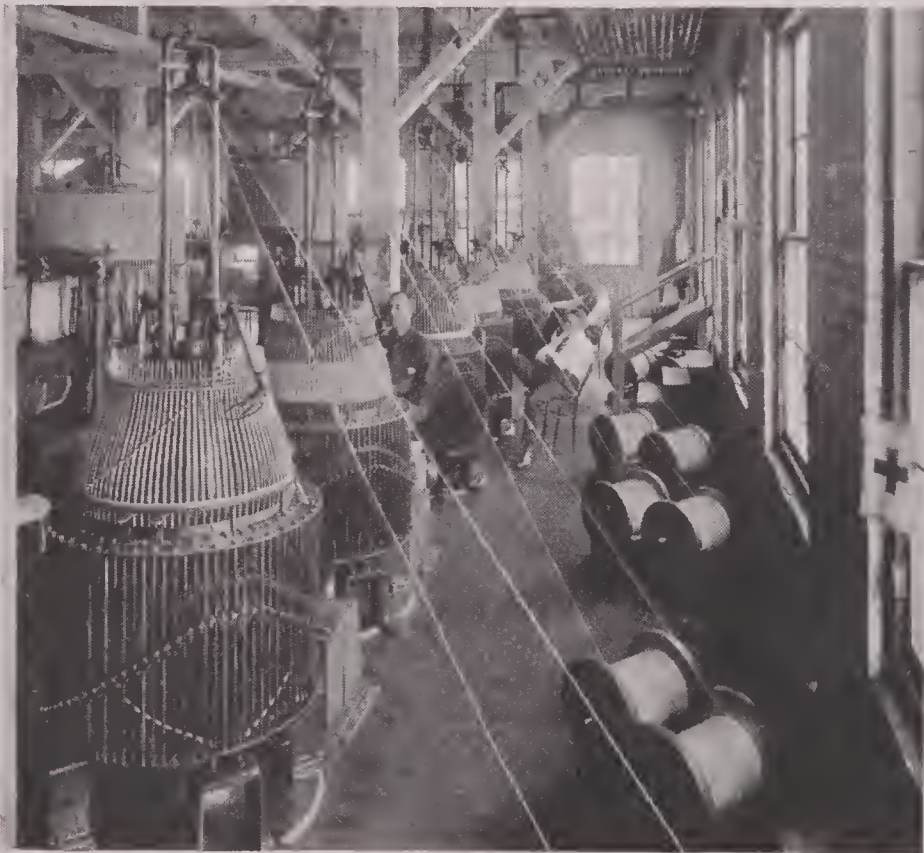
Baskets made 6,000 years ago have been dug up from the dry sands of Egypt. When the Romans visited Britain in the first century before Christ, they found the natives already very proficient in the making of baskets of willows, or osiers, much like those still made there today. Indeed it is from these early Celtic inhabitants of Britain that we get our English word "basket."

Basket-making has been found among all primitive peoples and is one of the most ancient of all the arts. As the earliest form of weaving, it may be regarded as the parent of cloth-making and all other textile industries. It is related to pottery, also, for the first clay vessels are believed to have been made by smearing clay on baskets and baking in the fire.

Among the American Indians, especially the western tribes, the art of basket-weaving reached its highest development and was of the greatest

Apache basket water-jars like these are made water-tight by coating with thin pitch. The outside is kept white with white earth. Thongs of leather or plaited hair are frequently added for carrying.

WEAVING BASKETS BY MACHINERY



For five thousand years mankind has been making baskets by hand, sticking the upright spokes into a frame and weaving cross-strips through them, but recently the machine here shown has been perfected. As the machine revolves the wicker is drawn from the spools on each side and into the shuttles.

importance. The new-born babe was placed in a cradle woven of basketry, and baskets were used in the burial of the dead. Almost every domestic necessity was supplied by the basket. They were even used to carry water. "How can water be carried in a basket?" you will ask. Some of the water-baskets were coated with gum to make them water-tight, but others

were so tightly woven that even without this coating they would hold water. With or without a lining of clay, baskets were used in cooking; of course they could not be placed over the fire, but hot stones were dropped into them to bring the water in them to a boil.

Basketry was also used in making various articles of clothing. Sandals made of it were used by some tribes instead of moccasins of hide. Head baskets, serving for protection from the sun and rain as well as for adornment, were the predecessors

of the straw hats we now wear in summer.

Captain John Smith speaks of shields and armor used by the Indians in warfare which were woven so

firmly that no arrow could pierce them. Basket boats were used by the Indians, as they were by the early Britons, and as they are to this day on the Tigris and Euphrates rivers (*see* Boats).

It was the woman of the household who made the baskets. She was the burden-bearer, and she early learned to weave vessels that were light yet strong and durable for carrying clay from the quarry, water from the spring, stones for grinding meal, firewood, fruits, seeds, roots, fish, flesh, and fowl to supply the household needs.

But she did not stop with this. Savage and uncultured as she was, the Indian squaw had a sense of beauty, and this she expressed in her baskets. She learned to extract dyes from roots and berries to color them. She made ornaments of shells and stones to decorate them. She stole the feathers of birds—the red of the woodpecker's crest, the orange of the oriole, the green of the mallard duck—to make more gorgeous the precious gift-baskets known as "jewels."

Most beautiful of all were the designs wrought into the baskets. Look at a collection of Indian baskets, and you will see how many of these designs represent objects in nature—the rainbow, the flowing water, the zigzag lightning, mountains, trees, flowers, birds, and animals. You will see, too, strange symbols, which if you could read them would tell of witchcraft and magic, legends of gods and heavenly beings. Into her baskets the weaver put her feelings, her dreams, and her prayers, the traditions and ideals of her race.

How You Can Make a Simple Basket

Boys and girls through patience and practice can learn to make beautiful baskets with simple materials and a very few tools. Those who live in the country can utilize some of the native materials used by the Indians—peeled twigs of the willow, or osier, split cat-tail leaves, flags and rushes, the tougher grasses, etc. Those who live in the city or who do not wish to take the trouble of preparing the native plants may use prepared materials, such as rattan and raffia.

Rattan is a vine-like palm which grows in the forests of India, twining about trees and hanging from the branches and sometimes reaching a length of several hundred feet. Before it comes to us it is stripped of leaves and bark and split into round or flat strips of various sizes, often called reeds. Raffia is a fiber obtained from the gigantic leaves of a palm that grows on the island of Madagascar. It comes to us in long strips that are very tough and pliable. In basket-making it is sometimes used alone, but more often in connection with rattan.

Here are directions for making a simple rattan basket. A heavier rattan should always be used for the spokes or ribs of the basket than for the weaving cane. The only tools needed are a pair of strong sharp shears, a ruler for measuring, and a deep pail for water.

Cut from the heavy rattan four 14-inch spokes and one 8-inch spoke. Have ready one of the finer reeds, to be used as the weaving cane, which you have previously soaked for an hour in cold water or fifteen minutes in hot. Arrange and cross the spokes as shown in Fig. 1, inserting the 8-inch or half spoke between the halves of one pair of spokes.

Hold the spokes in position by the left hand, and taking the weaving cane in the right hand bind it firmly about them as shown in the diagram, going twice around. Then separate the spokes so that they radiate at equal distances in all directions, as shown in Fig. 2. Now begin the weaving—that is, pass the weaving cane over one and under the next spoke, going from left to right. The spokes should be very evenly separated and the weaving cane pressed down firmly with the

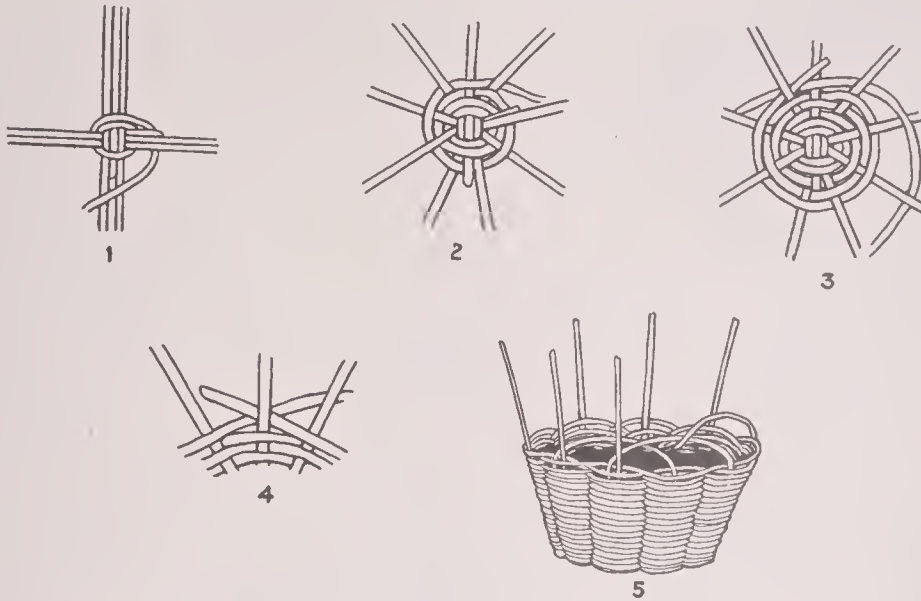
forefinger as it is brought around. Upon the care with which you do this will depend the strength and beauty of your basket.

When you have a mat or base several inches in diameter, wet the spokes and bend them sharply upward to make the sides of the basket. If the basket is to have straight sides the spokes should be bent at right angles; if sloping sides, at an oblique angle. In weaving the sides care should be taken to press each row close to the one before it. Two or more weaving canes will be needed to complete this basket. When the first weaving cane runs out, leave about half an inch behind a spoke and cross this with an equal length of the new weaving cane, as in Fig. 3.

To finish the edge of the basket, cut the spokes to an even length of about three inches beyond the weaving and trim each to a point. Hold the ends in water for a few minutes to make them pliable. Now turn back each spoke the opposite way from which you have been weaving and insert the point beyond the next spoke. Bend downward at least an inch below the edge of the weaving so that it will remain firmly in place, and press the top level with the last line of weaving.

BASKETBALL. Like lacrosse and hockey, basketball is an exceedingly fast game. It requires speed, ability to dodge with extreme quickness, and a keen eye for the goal. It was invented in 1891 at the training school of the Young Men's Christian Association in Springfield, Mass., by James Naismith, in response to a demand for a game that could be played indoors in winter to take the place of baseball and football. With surprising rapidity it spread to schools, colleges, and athletic clubs all over the United States, and after a time made its way across the Atlantic to the British Isles.

THE FIVE STEPS IN MAKING A BASKET



Whether you live in the country or in town—for there is plenty of material to be had in both places—boys and girls can get a great deal of pleasure as well as training in skill of hand from making baskets. These pictures show the five steps in the process, as explained in the text.

The game may be played either indoors or outdoors on any level space on which a rectangular court, not exceeding 4,000 square feet, can be marked out. At each end of the court there is a goal ten feet above the ground in the form of a metal ring, 18 inches in diameter, with a net of cord suspended from its rim. The ball is a leather sphere, 30 to 32 inches in diameter, with an inflated rubber bladder inside.

Here We Get into the Game

There are five players on a team—a center, two forwards, and two guards. At the start of the game the referee goes to the middle of the court and tosses up the ball between the opposing centers. Each team then tries to throw the ball into its opponent's goal, and every time it succeeds, scores two points. It is permissible to bat the ball with the hands and to throw it, but it may not be carried, kicked, or punched. No player may tackle, push, or hold an opponent. When a player breaks one of the rules, the

opposing side is given one free throw for the basket from a distance of not less than 15 feet. One point is allowed for each goal so secured. If, when

each goal is scored, the referee puts the ball in play again, by tossing it into the air between the two centers, as at the beginning of the game. If any player sends the ball outside the boundaries of the court, either by throwing it or by batting it with his hands, the referee blows his whistle and gives the ball to a member of the opposing team, who then endeavors to throw it into the court in such a way that one of his team-mates will secure it.

Team Work is the Thing

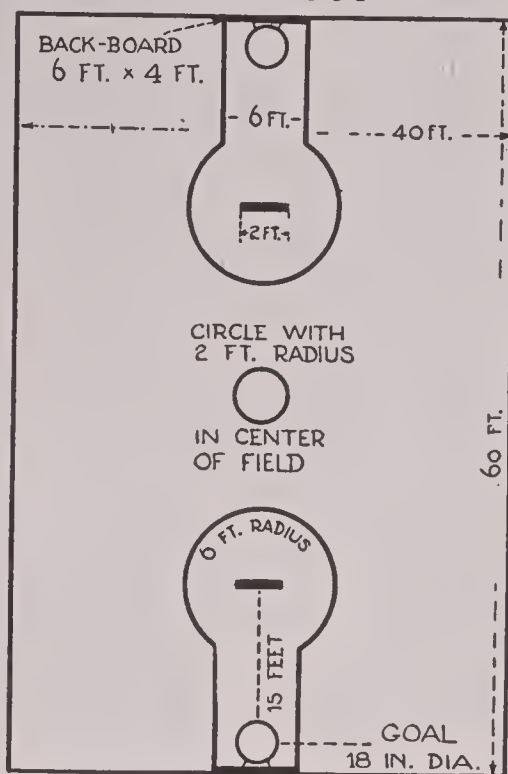
In the early years of the game it used to be the practice for the two guards to limit themselves, for the most part to the task of protecting their goal from the attack of the opponents. The two forwards were trained to carry the offensive against the enemy and were not expected to act as guards. The center was the "rover" of the team and supported the guards or the forwards whenever they needed assistance. Now, however, as the best teams play the game, there is very little difference between the duties of guards, forwards, and centers. The team plays as a unit, taking the offensive when necessary, and whenever

possible forcing the play toward the opposing team's goal. It is not uncommon for the guards of a good team to score more points than the forwards. Team play, as in so many other sports, is the vital element. The basketball five that guards together, passes together, and shoots together is the team that usually wins.

The rule that no player may carry the ball forward or backward makes basketball very largely a passing game. The ball moves back and forth from one player to another with great rapidity, and all five members of the team are constantly on the move, seeking to elude their

opponents. Although it is forbidden to carry the ball, a player may "dribble"—that is bounce the ball back and forth between his hands and the floor

HOW A BASKETBALL COURT IS LAID OUT



A BASKETBALL CHAMPIONSHIP GAME IN FRANCE



This picture has special interest both from the standpoint of outdoor sport and history. It shows one of the championship games played by American troops in France in July 1919. The man in the center has just made a free try for goal. If the ball enters the basket, his side scores a goal.

a team is making one of these free tries for the goal, the ball fails to fall through the basket, it is automatically in play and the game continues as before. After

in such a way that it keeps pace with him as he dashes towards his opponents' goal. When he is within "shooting" distance, he seizes the ball and sends it upward toward the basket. A good dribbler is an important asset for any team.

Difference between "Boy" and "Girl" Basketball

The main difference between basketball as played by boys and the game as usually played by girls is that in the latter there is a restriction against the players' running from one end of the court to the other. The guards have stations from which they are not allowed to move, and the other players are restricted in a similar manner. In many girls' camps, and in schools that are equipped with outdoor basketball courts, the regulation form of the game is followed, for it has been found that if the play periods are not too long, the girls are as well able to cover the whole court as the boys.

BASS. A common fresh-water fish related to the perch. The black bass, which is found only in American waters, is among the finest game fishes of the world. (See Fish.)

BAT. What animal is man's nearest relative among all the native creatures of the United States? You would never guess that it is the weird night-loving bat, the mouselike creature with the dragon wings.

Scientists tell us that as we go down the scale of life we come first to the apes, then to the lemurs—the fox-faced monkeys of Madagascar and other tropical



This is a Collared Fruit Bat carrying her baby, which clings to her fur, hanging upside down just as its mother does.

countries—and then to the bats. But no monkeys or lemurs have their natural home in the United States, so that leaves us with the bat as our nearest cousin.

At first sight we are ashamed of our relative. He's certainly not handsome, nor does he look very intelligent as he hangs upside-down from a twig, blinking his beady little eyes in the daylight. But wait; you'll admire him more when you learn to know him better.

Do you see those strange wings of thin dark skin which the bat wraps around him like a cloak? These are perhaps the most delicate sense organs in the world. Take the bat in your hand. He won't hurt you if you're gentle and avoid that frightened snarling mouth. You'll feel the small creature trembling all over. That's because, to those sensitive wings, the touch of your palm is like a rasping file.

Wings that "See" in the Dark

Those wings and his big vibrating ears are the mystery and wonder of the bat. They enable him to fly in the darkest night, through the thickest forest, when his eyes are of little use to him, and pursue his insect prey without striking a single trunk or branch. They are made up of a close network of fine nerves which seem to be able to detect in advance the slightest vibration in the atmosphere, caused by the friction of air currents against solid objects. Experimenters have sealed up the eyes of bats with gum, and released them in a large room where many ropes were suspended from the ceiling. The bats flitted about with their customary bullet speed, without striking one of the obstacles.

Because bats have wings they used to be classed with birds. But they are, of course, mammals, because they bring forth their two or three young alive and suckle them. The young bat is at first very tiny,

THE WINGED NIGHT-POLICEMEN ON THEIR ROUNDS



The Noctules, or Great Bats—you can tell them by their large size and broad rounded ears—are among the first to go on duty chasing insects on summer evenings. Like other bats, the Noctule is no hand for walking, but when it does walk it takes the queer position shown.

naked, and pink, but it clings vigorously to its mother's breast as she darts through the air. When at rest, the mother bat folds her delicate wings around her young to keep them warm.

Bats usually spend the day in caves, hollow trees, thick bushes, church towers, or old barns and deserted



A close relative to the Noctule Bat is the Hairy-armed Bat here shown. It gets its name from a broad band of fine short hairs under the wing, running from the forearm to the wrist.

buildings. They do not alight on the ground if they can avoid it, for they crawl with great difficulty, and they cannot spring into the air from a flat surface, but must climb up a little distance in order to launch themselves on their flight.

The Little Policeman with Leathery Wings

There are altogether about 300 kinds of bats, distributed all over the world, except in the very coldest regions. As a rule they are small, but the flying-foxes of the Malay region have a spread of wings sometimes measuring five feet. These and other large bats found in the tropics are fruit-eaters and do much damage to crops; but the northern bats feed on insects, and so are very valuable to man. Indeed, the bat may be looked upon as the night policeman of our crops and gardens, for it devours enormous quantities of harmful moths and flying beetles.

In certain parts of the South huge bat roosts or shelters are built and maintained at public expense, and where this has been done mosquitoes are rapidly destroyed. Children, therefore, should be gentle with their tiny flying cousins who, in spite of their strange appearance and harsh squeaking voice, are friendly and easily tamed if carefully approached.

Bats have always had an undeservedly bad reputation, and many silly tales have been told about them, such as the superstition that they take delight in entangling themselves in women's hair. There are,

however, certain tropical *vampire* bats which settle on the backs of horses and cows or even on sleeping human beings, and suck their blood, sometimes so weakening their victims that they die. These greatly dreaded little creatures have such small gullets that nothing but liquid food can pass through. They are common in parts of Central and South America, but are never found in the United States. These blood-sucking bats get their name of vampire from the "vampires" of legend—ghosts which come out of their graves at night, according to the superstition, and suck the blood of human beings. The belief in such supernatural beings still exists in backward parts of Europe.

The name of the order of bats is *Chiroptera*, from the Greek words meaning "hand-winged." If you look closely at a bat's wing, you will see that the bones correspond roughly to the fingers of your hand, the hook at the top representing the thumb. The species most frequently seen in the northern United States are the little brown bat (*Vespertilio subulatus*), and the red bat (*Lasiurus borealis*). Scientific name of common vampire, *Desmodus rufus*.

BAVARIA, GERMANY. The fertile plateau and green-clad mountains of Bavaria, the most southern of the German states, reflect the spirit of a people far different from the light-haired "efficient" Prussians of the low-lying sandy plains to the north. The Bavarians are more largely dark haired, with easy-going, tolerant temper. They are instinctive lovers of music and color, and their country is the true home of German art.

Careless of the rush of modern factory industry,

A BAVARIAN FOLK DANCE



A traveler in Bavaria took this snapshot of one of the most popular of the Bavarian folk dances. It is somewhat like the Virginia reel, except that it is danced by one man and two women instead of two couples. They dance separately at first, the man and the women alternately advancing toward one another and retreating. Later in the dance the women circle around the man several times, as they are doing in the picture.

the Bavarian countrysides have kept something of the warm picturesqueness of the Middle Ages. The peasants in the more remote valleys still wear quaint costumes, rich with embroidery and silver buttons. The herd-girls, in their dark full skirts and scarlet

bodices with white sleeves, may still be seen guarding their flocks on the distant hills as their forebears did four and five centuries ago. Even in the towns descendants of the famous gild craftsmen of former days still labor in their little shops, turning out the skilled handwork in wood and metals for which medieval Germany was celebrated the world over.

Cut off by wooded mountains to the northeast and northwest, and by the towering snow peaks of the Alps to the south, Bavaria has until the past century run a separate course in spirit and politics from the rest of Germany. When their northern neighbors followed Luther in the Protestant Reformation, the Bavarians remained Roman Catholic. When Napoleon overran Europe, Bavaria sided with the French. When Prussia and Austria fought in 1866, she helped Austria. Even after the formation of the German Empire in 1871, Bavaria kept her own army and postal system, her own laws and customs, and her own royal family, which continued to rule until the revolution of 1918.

From the days of the Roman Empire, whose boundaries followed the rivers Danube and Main squarely through the middle of Bavaria, the Bavarians have been intimately associated with Italian civilization. A rich commerce flowed northward over the Alpine passes to the ancient cities of Augsburg, Regensburg (Ratisbon), and Nuremberg. Bavaria thus early became a center of wealth and learning. Out of these intimate associations, in which Bavaria formed the link between the Latins to the south and west and the Teutons and Slavs to the north and east, grew the cordial adaptable spirit found in present-day Bavaria.

Today the pack mules, laden with the rich silks, tapestries, and spices of the East, which wound their way through the passes of the Alps, are replaced by iron rails and locomotives. But old Nuremberg is still the commercial and industrial center of south Germany. Munich, the capital of the state, as well as the literary and art center of Bavaria, presents a thoroughly modern appearance with its broad streets and beautiful buildings (*see* Munich; Nuremberg).

Everywhere beer-making, the ruling industry of Bavaria, is in evidence. In the cities brewery chimneys mingle with tall church spires, and in the country the straight white roads, dotted with Catholic shrines, lead through rolling hills clad with graceful hop vines. In the Alpine foreland cattle-raising is the principal industry. There shingled wooden cottages of an Alpine type prevail, which in the more agricultural lands towards the Danube give place to tiled farmhouses. Lack of coal is one of the chief handicaps of Bavarian manufactures.

Amid the mountains of southern Bavaria lies the little village of Oberammergau, where every ten years the villagers produce the Passion Play of Christ's crucifixion. The peasants play all the 350 parts—Jesus, Mary, Pilate, Caiaphas, the Apostles—and the preparations are long and earnest. The drama takes

all day with a noon intermission, and is performed on 12 days, to crowds that come from all over the world.

Bavaria was organized as a duchy before the days of Charlemagne while Prussia was still inhabited by barbarous Slavs. Napoleon in reward for its aid conferred the title of king (in 1805) on the ancient ruling house of Wittelsbach, which continued to govern until deposed at the end of the World War. Bavaria remains today the largest and most populous state of the German Republic after Prussia.

The German name for Bavaria is *Bayern*. Area, 30,819 square miles; population, about 6,900,000.

BEAN. If you don't "know beans" you have missed one of the most valuable of garden vegetables, for beans furnish more nutriment at a lower price than any other of our staple foods, even wheat. Many varieties of them are grown throughout the world, forming a large part of the food of the human family. They are so rich in protein that in a measure they can be used to replace meat in our diet.

Bean plants are annuals, grown as low bushes or vines from seed. They have clusters of creamy butterfly-shaped flowers, which are followed by pods, usually from two to eight inches long, containing the seeds or beans. One recently developed variety has pods as long as a man's arm. The beans in the pods vary in size and color, often being beautifully marked with contrasting hues, like the famous beans for which Jack the Giant Killer sold his mother's cow, in the old nursery tale. The entire bean plant is sometimes used as stock food. The roots are valuable soil renovators.

The best-known bean of the United States is the white navy bean of the famous "Boston-baked" type. It is one of the more than 150 varieties of the kidney bean—the "haricot" of the French—the original stock of which is thought to have come from South America. This species also includes the many varieties of wax and string beans eaten green with the pods, or shelled and dried.

The lima bean also came from South America. It has large flat beans in a broad pod that grows on either a bush or vine. The pod is not edible, but the seed is eaten both green and dried. Tepary beans and the small flat black frijoles are much used beans of Mexico and other Latin-American countries, where they rank next to corn as a staple food. They also grow in the southwestern United States. The cowpea, also called the black-eye bean, is the chief forage and green manuring plant in the south of the United States, and the shelled seeds are eaten green or dried (*see* Cowpea).

Soy beans are the common beans of China, Japan, and India, where they are an important item in the diet of the rice-eating Orientals. They are not eaten as a vegetable, but are prepared in a great variety of complex forms, such as a sort of cheese made by crushing, boiling, and curdling into cakes. In America the soy bean is grown as forage, as soil food, and for silage (*see* Soy Bean).

THE EARLY LIFE OF JACK'S BEAN-STALK



That famous bean-stalk which shared with Jack the honor of disposing of the giant started in life in just the humble way shown in this series of pictures. In the first the withered pod has opened and started little Mr. Bean on his career. The autumn rains wash the seeds into the earth crannies and bury them under the mold.



With the coming of spring we see the process of germination. The two halves, or "cotyledons," of the seed split open. The root starts down in search of food, while the embryo leaves, which at this stage of their career form a little bud called a "plumule," start up in search of a supply of sunshine.



No matter how the seed lies, the root always persists in going downward and the leaves in climbing up to catch the sun rays. Botanists have tried, by fastening growing seeds to rotating discs, to make the leaves and the roots change their minds, but they never do! In the last two pictures the little plant is thoroughly established in business, and the leaves have opened out.

For any subject not found in its alphabetical place see information

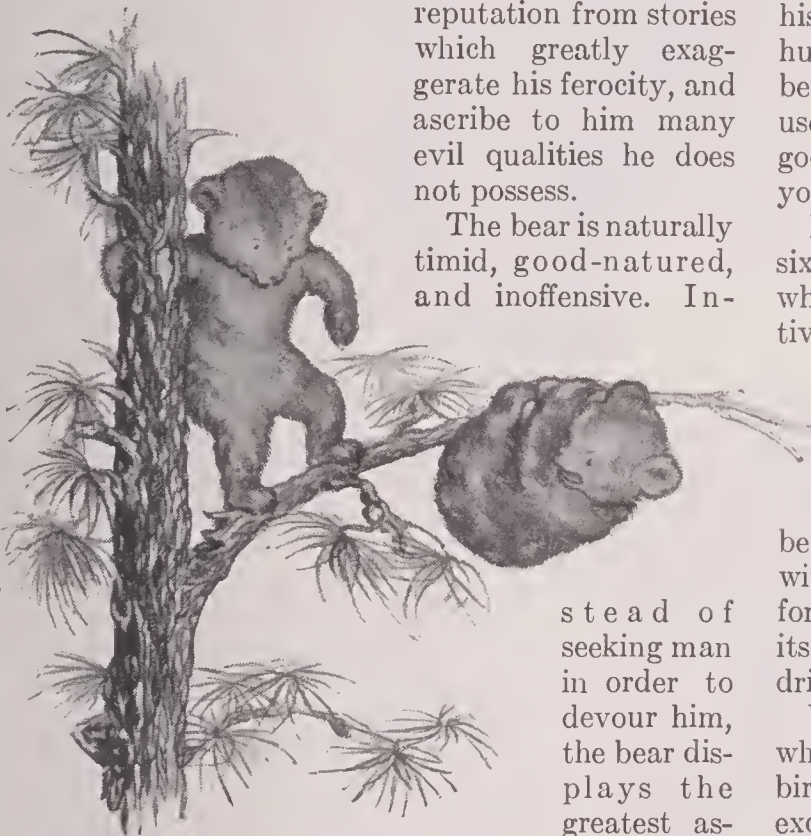
The common bean of Europe is the broad bean, which has been used as food for both man and animal since the remotest times. Our scarlet runner is an ornamental climber, which in Europe is also grown as a string and shell bean.

Beans are prepared for winter use in various ways. Enormous quantities are ripened, shelled, and dried. Dried beans are also cooked, seasoned ready for the table, and canned as baked beans. String beans are also canned.

Beans are legumes of the family *Fabaceae*. Scientific name of the kidney bean, *Phaseolus vulgaris*; of lima bean, *Phaseolus lanatus*.

BEAR. Among the four-footed inhabitants of the wilderness there is none that is better known or more interesting to people of all ages than the bear, nor is there one that is so generally misunderstood, or about which so many things are said and believed that are not true. In common with many flesh-eaters, the bear has suffered in reputation from stories which greatly exaggerate his ferocity, and ascribe to him many evil qualities he does not possess.

The bear is naturally timid, good-natured, and inoffensive. In-



How would one know that these were *young* bears even if one didn't see them and somebody just said he had seen the bears climbing the trees? The article tells.

stead of seeking man in order to devour him, the bear displays the greatest astuteness in his efforts to avoid man. But he is not

a coward. He is fully conscious of his strength, and when occasion arises he never fails to defend himself. Like a true gentleman, the bear tries to avoid trouble, but when his peaceful efforts fail he fights savagely.

Bear Characteristics and Habits

In appearance the bear is a clumsy creature. The middle of his back is the highest point of his body. He has a short neck, round head, pointed muzzle, and small eyes. His legs are stout and he walks "plantigrade," or flat-footed, like a man. The soles of his feet are bare. Each foot has five toes, armed with

long stout claws which are not retractile—that is, they cannot be drawn back into a sheath like those of a cat. His hair is long and shaggy and is shed annually. The tail is very short. The teeth clearly indicate that the bear is "omnivorous"—that is, that he eats almost everything. The canine or "dog" teeth are long and sharp for tearing flesh, while the molars are well adapted for grinding roots and other vegetable foods.



Here you see the comparative size of the foot of a Grizzly and a boy's hand.

The bear walks with a shambling gait, lifting both feet on one side of his body at the same time. His clumsy movements when at ease are very deceiving, for he can turn with surprising swiftness and deal terrific blows with his forepaws with the agility of a cat. In running he goes at a sort of gallop, and his speed is such that he can overtake the swiftest human runner in a few minutes. In attacking, the bear frequently, though not always, stands erect and uses his forepaws as well as his teeth. Bears are good swimmers, and most kinds climb trees while young.

In the wild state most bears hibernate from two to six months during the winter, even in warm climates where food is plentiful the year around; but in captivity they rarely do this even in a cold climate.

When cold weather approaches the bear seeks a secluded spot and a suitable den for its winter quarters. Sometimes the base of a hollow tree is chosen, or a cavity under the roots of a "blow-down" or fallen tree; or the bear may scoop out a den for itself. It covers itself with leaves, grass, or dirt, leaving only an air-hole for its breathing. The bear is not dormant during its period of hibernation, but it takes no food or drink (see Hibernation).

Young bears, called cubs, are born in January, while the mother is hibernating. Two cubs at a birth seems to be the rule with bears, but there are exceptions. Baby bears are nearly hairless at birth and ridiculously small, considering the size of the parents. They are helpless for many months, and remain with their mother the first year and go into the den with her the second winter.

Though classed as *carnivores* or flesh-eaters, most bears subsist largely on a vegetable diet. They eat grass, grain, roots, nuts, berries, fruit, grubs, insects, frogs, snakes, mice, snails, crabs, eggs, fish, birds, and any other kind of game they can capture or find in good condition. They do not eat carrion. Most bears are fond of ants, probably on account of an acid which these insects secrete, and to obtain them the bears use their strong claws to tear apart decayed stumps and logs, and to dig up ant-hills. They are also passionately fond of honey, and will travel many miles to get it.



Different kinds of bears are widely distributed throughout North America, Europe, and Asia, and some parts of northern Africa. Only one species is found in South America, and none in Australia.

The bears of North America constitute four distinct and easily recognized groups. Their common and scientific names are: Black bear (*Ursus americanus*); Grizzly bear (*Ursus horribilis*); Alaskan brown bear (*Ursus gyas*); Polar bear (*Thalassarcos maritimus*).

The black bear was originally found in all parts of the North American continent, except in the extreme north, and it still exists wherever there is extensive forest land sufficient to shelter it. Though persistently hunted for several hundred years, it is still found in the Adirondacks and in New England. In the fall when the coat of this bear is at its best, the fur is entirely black except for a

brown patch on the muzzle and an occasional white spot on the breast. Its hearing and sense of smell are very keen and enable it to avoid its enemies. The least suspicious sound or odor is sufficient to start it from its lair; and it requires a skilful hunter to run it down or approach within rifle range. A large black bear may weigh 500 pounds or more, but the normal weight is much less.

The cinnamon bear is a color variation of the black bear, both types being found in the same litter. For a long time after its discovery the cinnamon bear was believed to be a distinct species, and most of the early accounts described it as being equal to the grizzly in size and exceeding it in ferocity. But science dissipates all illusions and superstitions; and since the true position of the cinnamon bear has been established, it is regarded as the shy inoffensive animal that it really is.

Five other forms or sub-species of the black bear are now recognized, four of which closely resemble the main type. They are found respectively in Florida, Louisiana, Labrador, and Queen Charlotte Island.

The fifth, known as the glacier bear, is of a rare bluish-gray and is found in Alaska, in the vicinity of Mt. St. Elias. Like the cinnamon bear, the glacier

bear was formerly thought to be a distinct species, but a litter of young ones, in which both types were represented, established the true relationship.

The black bear is often seen in captivity and is a favorite with young and old. Its habit of standing erect, its droll appearance, and its plaintive appeals for dainties, which are generally accompanied by a whine like that of a child, give it a human aspect. This is further heightened by the amusing antics of the cubs, which may be likened only to the romping and wrestling of boys. Bears have a keen sense of humor, as evidenced by their fondness for ducking one another in a pool. Dr. Hornaday says bears are easily kept in captivity, and if properly

fed and not too closely confined they are good-natured and contented.

America's Fiercest Animal

The grizzly bear, or "silver-tip," inhabits the western part of North America from the Arctic Ocean to southern Mexico, and from the Rocky Mountains to the Pacific. There are several varieties. In size some about equal that of the black bear, but the largest attain a length of ten feet and a weight of almost 1,500 pounds, and are capable of carrying off small horses and cattle. They vary in color from a light yellow to almost black. The tips of the hairs are lighter, giving them a grizzled appearance, whence come the names grizzly and silver-tip.

The grizzly is the fiercest and most dangerous American mammal. The Indians feared it and the warrior who overcame a large one was very properly regarded as a great brave. The grizzly possesses greater intelligence than the black bear, and when wounded or brought to bay is a dangerous antagonist. The coming of the white man with firearms marked the beginning of the end, and like other big game the

THIS ALWAYS AMUSES THE CHILDREN



One of the keepers is asking one of the Black bears in that wonderful collection of animal life, the New York Zoo, to stand on his hind legs for the amusement of the children.

TALES THE WOODMAN TOLD

THE STORY OF JOHNNY BEAR



ONCE there was a Woodman who was Wondrous Wise and knew all about bears and everything, because he lived right out in the woods with them. And once there was a Little Boy who liked bear stories very much; and since the Woodman liked the Little Boy, he told him all about bears, and this is what he told him:

This is the Woodman, and — this is the Little Boy

“oh, terribly funny! But little bears are funnier. And bears are also very wise but they walk awfully funny. Did you ever see bears walk?” asked the Woodman.

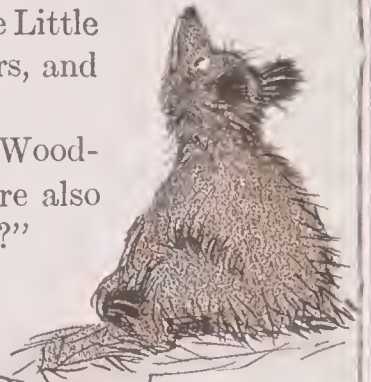
Little Boy said he hadn't.

“They make great big tracks like this,” said he, drawing with a piece of chalk. “See the tracks and the marks of their claws? That's because they can't draw in their claws like a cat; and another funny thing is that they step with both feet on the same side at the same time; that's what makes them wobble so.

“Now,” said the Woodman, “I am going to tell you a story about a little bear named Johnny.



Johnny stretched and said “Ho-hum!”



A bear has a wonderful nose for news, specially sweet news—



so he started off down hill—

“Johnny Bear had been sleeping under a big tree and awoke when the sun came up. Johnny stretched and said ‘Ho-hum!’ just like that—‘Ho-hum!’ Then he sat up and rubbed his eyes and said, ‘I'm hungry!’ Then he sniffed the air in all directions, and all of a sudden he began to smile, for he smelled a wonderfully sweet smell. You

know a bear has a wonderful nose for news, especially sweet news; so he started off down hill—did I tell you he slept on a hill? Well, Johnny was terribly hungry, and in a big hurry, so he started to run. But that's one thing a bear can't do; he can't run down hill, because his hind legs are longer than his front ones, and the first thing Johnny Bear knew he was tumbling head over heels right down the hill!

“But Johnny didn't mind a bit; he just picked himself up and followed his nose for about a mile.

“Now what do you think it was that he smelled?” asked



—head over heels right down hill!

the Woodman.



**He followed his nose
for about a mile—**

climbed up and poked it right into the bees' nest."

"O-o-oh! didn't he get stung?" asked the Little Boy.

"Well, yes—a little," said the Woodman. "But Johnny didn't care about that for the honey was so good, and he ate and ate and didn't stop eating until all the honey was gone. Then he backed down the tree, rubbed his paws over his face to get off the honey, licked his paws, and walked off!"

"But what happened to the bees?" asked the Little Boy.

"They were still after him," said the Woodman. "But they couldn't sting him very much on account of his thick coat, and besides he knew that after he swished

around through the brush a little the bees would leave him.

"Johnny Bear was feeling quite contented with such a good breakfast; so he hunted up a nice shady spot to go to sleep and curled himself up, putting his paw over his nose, even

"I don't know," said the Little Boy.

"Well, I'll tell you," said the Woodman, "he smelled *honey*. Of course the honey was in a nest of bees, but that didn't bother Johnny any. When he came to the tree where his nose told him the honey was, he just



**"Oo-oh! didn't
he get stung?"**



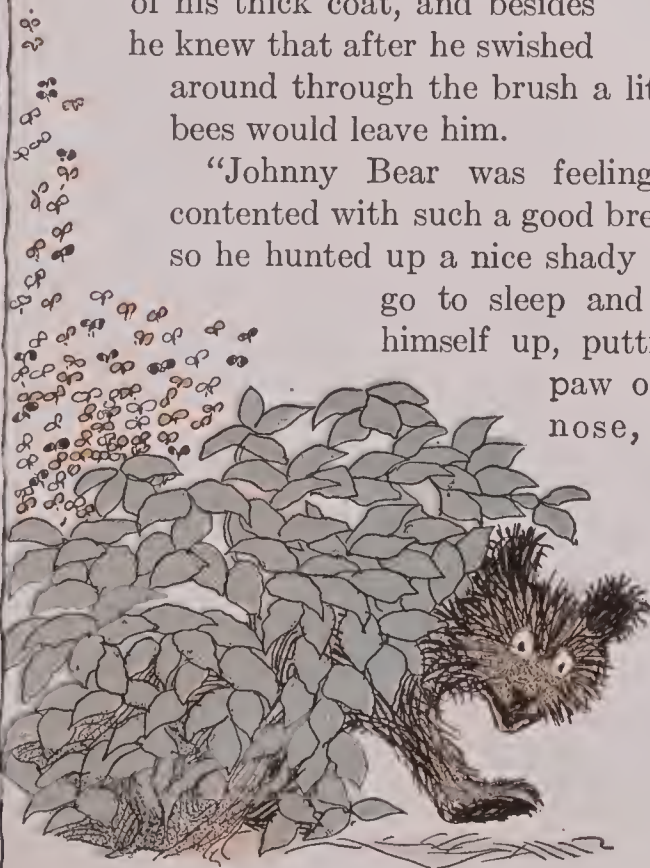
**and poked
it right into
the bees'
nest!**

though it was a warm day, for bears always sleep with their noses in their paws."

"What for?" asked the Little Boy.

"I don't know," said the Woodman, "unless it's to keep the flies off. Well, Johnny hadn't been sleeping very long before his sister and his mother came along and woke him up. Johnny

was feeling quite playful by this time, so he and his sister started the funniest boxing match you ever saw. They'd tumble each other over, then wrestle awhile, and kick and paw each other, then make believe they were angry and bite each other. And so they played until they got hungry again, while Mother



**He curled himself up, putting
his paw over his nose.**



His mother and sister came along —

Bear watched and kept an eye out for danger.

"Pretty soon she said they'd better be looking for dinner, so the little bears were all attention and started sniff-sniffing around old logs and stones and things for—what do you suppose? Grubs! Now if there is anything a bear likes better than anything else, it's honey or syrup, and next he likes the great big juicy white grubs that by and by are to turn into beetles.

So they went sniffing around, and every once in a while—snap! they'd have a grub. But pretty soon Johnny came to a big flat stone, and Johnny just knew there were lots of grubs under that. Sister knew it too, but they couldn't turn the



It was the funniest
boxing match
you ever
saw



Mother Bear came
and held up the stone



and woke him up

stone over; so they called Mother Bear, and she came and held up the stone while they ate the grubs all up."

"Ate them all up," asked the Little Boy, "while Mama Bear held up the stone?"

"Yes," said the Woodman, "I saw it with my own two eyes. I've seen mother bears do that more than once.

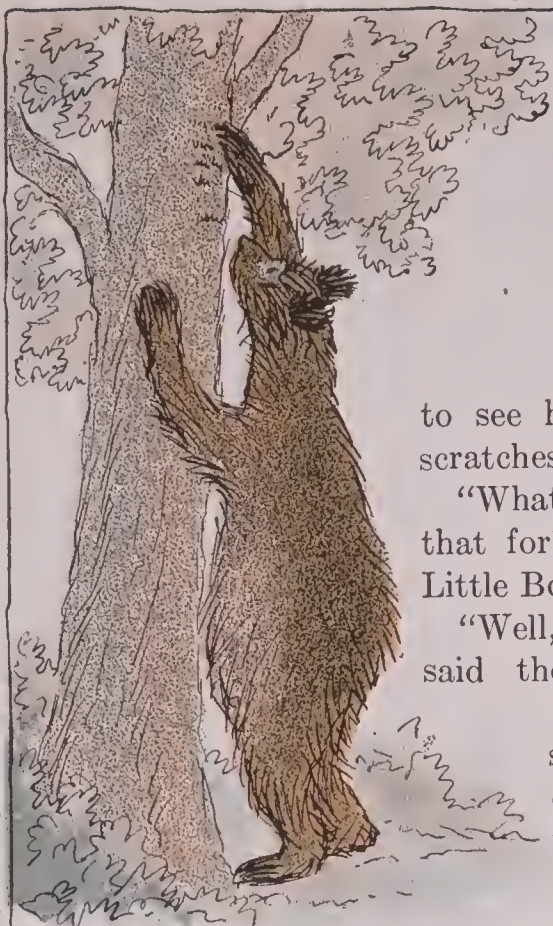
"When they were just ready to move on, they heard a crashing of branches and leaves, so they all stood up very quietly—yes, stood right up on their



hind legs,
because
you know
bears can

all stand erect, even baby bears; bears can even walk that way, but not very well—and over by a big tree they saw old Mr. Bear carrying on at a great rate. First he'd stretch 'way up and claw the bark, and stand off and look





to see how high his scratches were."

"What did he do that for?" asked the Little Boy.

"Well, you see," said the Woodman, "he saw by some scratches on the tree that there had been another

He'd stretch way up and scratch the bark—

big bear along the path and scratched the tree as high as he could reach; for that's the way a bear always does—to show the next bear who comes along how big he is, I guess. Anyway, old Mr. Bear after trying two or three times made a scratch a little bit higher than the others. First he sat back and looked at it a bit, and then started off down the trail, looking for the other bear, growling to himself at a great rate.

"After that Johnny Bear went down to a nice stream where he knew there were some fish. He took his position on the bank, as Mother Bear had taught him, and waited until a fish came along when—flip! he put his paw under a fish and tossed it out on the bank, and then ate it. It was just a little fish, but Johnny was pretty proud of himself. The next one was a little bigger, and so Johnny fished until he got tired and full and sleepy, then he went home and I



then stand off and look

suppose when he saw Mother Bear that evening he told her a big fish story about the fish he caught."

The Woodman didn't say any more, so the Little Boy asked, "Is that all about bears?"

"Well, that's all about bears today," said the Woodman.



It was just a little fish, but Johnny was very proud of himself



He told Mother Bear a big fish story



The Polar Bear at the left is one of the most accomplished members of the bear family. He can swim fast enough to catch a seal, can run with surprising swiftness over the ice, and is a terrible fighter. The "Silver-Tip" Grizzly, at the right, is so named because the tips of the hairs in his coat are light gray. Heavy as he looks, this bear can gallop over rough ground at great speed.

grizzly bear would be in serious danger of being exterminated were it not for the protection given in the Yellowstone and other national parks.

The *Alaskan brown bears* are found only in Alaska. They attain the enormous weight of 1,500 pounds, and are not only the largest living bears, but the largest living carnivores which are found on land. Yet their existence was unknown prior to 1896. They are afraid of man and flee from his presence, but when wounded or suddenly surprised at close quarters they will fight furiously. They spend much of their time hunting for mice, ground squirrels, and marmots, which they dig out of their burrows. When the salmon come up the rivers, these bears gorge themselves on fish. In mid-summer and fall these huge carnivores present the curious spectacle of grazing like cattle.

The *polar bear* is appropriately dressed in white to harmonize with its surroundings. It is completely covered, even to the soles of its feet, with long thick fur. It is a powerful swimmer and even in midwinter is perfectly at home in the water. Only the female polar bear hibernates. Her winter den is a cavity under the ice and snow, and there she brings forth her young. Until they are quite grown the cubs remain with their mother, who cares for them, teaches them, and protects them from harm. Dr. Nelson says: "When a mother polar bear scents danger she jumps into the water and her cub holds fast to her tail while she tows it to safety. But when no danger seems to threaten she wants it to 'paddle its own canoe,' and boxes its ears or ducks its head under water if it insists on being too lazy to swim for itself."

The male polar prowls about on the ice during the long winter night, subsisting on fish, seals, walruses, and any other food he can find. When in dire need he does not hesitate to attack men, and many an Eskimo

has fallen a prey to his attacks. In summer, when food is plentiful, he never attacks man except in self-defense.

Bears of Europe and Asia

The *brown bear* of Europe (*Ursus arctos*) resembles the grizzly more than any other American bear. It is larger than the black bear and more dangerous to man, although by no means as blood-thirsty as is commonly reported. It attacks man only when provoked or when suffering from extreme hunger. An account of this bear which tells how it attacked a camping party surrounded by a circle of fire, by first plunging into water and then rolling across the fire to extinguish it, makes a good story, but overstates the intelligence of this dull-witted creature.

The strength of the brown bear is almost unbelievable. It has been known to kill a cow and carry it across a small stream in its fore paws, walking upright on its hind legs. Another authentic account tells how it dragged a deer weighing 600 pounds from a pit and through the woods three-quarters of a mile. The range of the brown



This is Mr. Brown Bear, who, although he lives in Europe, is very much like his American cousin, Mr. Grizzly. For strength, as the article tells you, he is one of the Samsons of his race.

bear is from the Atlas Mountains in Africa across Europe and Siberia to Kamchatka.

The *Himalayan bear* (*Ursus torquatus*) is found in Asia from Persia to Japan. It resembles the black bear in size, color, and habits.

The *Malayan, or sun bear* (*Ursus malayanus*), is smaller. It inhabits the Malayan peninsula and the larger East Indian islands.

BEATTY (*bā'tē*), ADMIRAL SIR DAVID (born 1871). During the last two years of the World War of 1914-18, the British Grand Fleet was under the command of Admiral Sir David Beatty, who by his skilled leadership was largely responsible for defeating the German submarine campaign.

Born of a good Irish family, he entered the British navy in 1884, becoming a commander in 1898, captain

in 1900, and rear admiral in 1910. In 1901 he was married to a daughter of Marshall Field of Chicago. He played a distinguished part in the World War from the beginning. In the battle of Jutland, May 31, 1916, he commanded the battle cruiser squadron, and engaged the numerically superior enemy in spite of heavy losses until the arrival of the dreadnought squadron under Admiral Sir John R. Jellicoe. When the latter was retired to shore duty in November 1916, to become later First Sea Lord at the Admiralty, Admiral Beatty succeeded him.

BEAVER. Have you ever heard the saying, "as busy as a beaver"? Anyone who has ever had the good fortune to see a colony of these water animals at work has no difficulty in understanding its meaning, for they are among the most intelligent and industrious of animals, and the dams and houses which they construct are wonderful products of animal skill.

The beaver belongs to the group of "gnawers" or rodents, and is the largest and heaviest of that family.

feet in diameter and two or three feet in height, and the floor is carpeted with bark, grass, and wood chips. There are two entrances, both under water. One, called the beaver entrance, is often winding in its course as a protection against enemies. The other is straight and is used both for taking in the wood for winter food, and as a means of escape in case of invasion by a mink or other water enemy. Both these entrances open into a moat around the house, too deep to freeze solidly, so that the beavers are not likely to be shut in.

Beavers as Engineers

In order that they may easily pass back and forth under the winter's ice, and that they may have room to store food, the beavers build dams to increase the water about the lodges. These dams are often of great size; indeed one is reported 1,530 feet long. The first step in dam-building is the selection of a suitable site, a narrow place in shallow water with firm bottom. Then work is begun of felling trees. Standing on



This is Mrs. Beaver, but not all these are her children, because, just look, there are one, two, three, four, five, six, seven, eight, nine, ten of them,—almost all of the same size! Beavers have only three or four babies at a time. Of course, she may have taken a half-dozen of them to raise. Beavers do that very thing when babies are left orphans by the death of their own mothers.

A large beaver measures about two feet from the tip of his nose to the root of his tail, which adds about a foot more. The weight of such a specimen is about 35 pounds, but large old specimens may weigh 75 pounds. The tail is not the least curious feature of the beaver, for it is broad and flat with a horny covering resembling scales. The front teeth are remarkably large, and like the front teeth of the squirrels, rabbits, and other gnawing animals, are hard in front and softer behind, so that by use they become worn to chisel edges. The beaver's hind feet are webbed for swimming and the flattened tail serves as a rudder and to splash the water for a warning signal. He is a splendid swimmer and diver. Frequently he remains under water for fully two minutes.

Beavers are social animals. A family of several members usually lives in one house; and sometimes a large number of families collect together in a community. They usually work at night and build their houses or lodges well concealed from haunts of man in small lakes or ponds made by damming up a forest brook. Their houses are oven-shaped and built of sticks, grass, and moss, woven together and plastered with mud, so strong as to protect the inhabitants from beasts of prey. The room inside may measure eight

feet in diameter and two or three feet in height, and the floor is carpeted with bark, grass, and wood chips. There are two entrances, both under water. One, called the beaver entrance, is often winding in its course as a protection against enemies. The other is straight and is used both for taking in the wood for winter food, and as a means of escape in case of invasion by a mink or other water enemy. Both these entrances open into a moat around the house, too deep to freeze solidly, so that the beavers are not likely to be shut in.

Some say that they always plan for the tree to fall toward the water; others declare that they work haphazard. After the tree is down the beavers set to work lopping off branches and cutting the trunk into lengths which they can drag into the water. The short logs, dragged or floated to the desired spot, are sunk parallel with the current, and if the water is deep they are kept down by means of stones, sod, and mud loaded on by the beavers. Mud and stones and heavier timbers are carried in their forepaws and small timber between their teeth. There is no superintendence in their work, but each beaver does what seems to him best. The result is that the dam is usually a tangled heap, but it serves its purpose. In old dams willow and poplar logs have usually sprouted and have sometimes given rise to considerable trees.

The beaver feeds mainly on the bark of trees (willow, poplar, birch, etc.), and on roots, buds, berries, and leaves. A store of good-sized green logs is always sunk in the water at the doors of their houses for winter feeding. When the trees near the water are

A PICTURE-VISIT TO A BEAVER POND



A beaver village, with its lodges and its dams, is always interesting, but it isn't often that you can get right inside the family life, as we do in this picture. It shows you not only just how the lodge is built and woven together, but about the family bedroom and the front room and the front door leading out under the water to the birch bough "pantry," and one of the beavers—likely enough, Mr. Beaver himself—swimming home with a nice fresh branch in his mouth.

used up and the land is too uneven for rolling, log-slides and canals are cut in the banks and bottom to carry down the timbers. These channels may be hundreds of feet long and about a yard in width and depth. One of the chief uses of the beavers' dam is to insure sufficient water to float these logs.

The soft thick gray under-fur of the beaver has long been highly valued by man, and during the 17th and 18th centuries beaver skins held first place in the world's fur trade. At that time, before the invention of the modern silk hats, men's hats were made from beaver skins and hence the word "beaver" often meant "hat." So great was the demand for beaver fur that in the western part of Canada and the United States beaver skins at times passed as currency.

Formerly this animal was distributed through the wooded part of the Northern Hemisphere, but it has been hunted until it is almost exterminated in settled portions. In the United States it is scarcely found east of the Mississippi. Occasional colonies are known, however, in Maine, Virginia, and a few other places.

Rigid protection is afforded in most American states and in eastern Canada, and a plea has been presented for a game and fur preserve in the Canadian northwest. In Itasca Park, in Minnesota, the beaver has in recent years multiplied rapidly under protection.

Friends of the beaver have encountered bitter opposition because of the damage it sometimes causes by flooding tracts of valuable timber. Its good deeds, however, outweigh the bad. By building a series of

HOW MR. BEAVER CHOPS DOWN TREES



Beavers cut down trees by gnawing through them with their sharp front teeth at the distance above the ground they can reach when standing upright. The tree is generally gnawed pretty equally all around, as you can see from these two stumps. The wood is usually cut away in very large chips.

MR. BEAVER'S TIME-LOCK TO KEEP OUT THE BURGLARS



Winter is the time when there are most burglars abroad in Beaverville, because then four-legged creatures of prey are most hungry and desperate. But Mr. Beaver's people ages ago discovered a way of putting a time-lock on all their doors so that no prowling wolves or wild cats, or other marauders can break in. He simply plasters his house thickly over with mud and lets it freeze. On the left is a picture of an unplastered and on the right a plastered lodge.

dams in mountainous districts, the beavers form ponds which hold the waters of the melting snows and give them out gradually during the summer to the arid plains. Thus they help to irrigate the land. Moreover their great economic value as a source of fur and their interesting habits should alone be a sufficient argument in favor of protecting them.

Scientific name of North American beaver, *Castor canadensis*. Other species were formerly common in England, France, Germany, and elsewhere, but are now practically unknown except in some parts of Scandinavia, Germany, and Austria, and in Siberia.

BECK'ET, THOMAS, ARCHBISHOP OF CANTERBURY (1118-1170). In the majestic cathedral of Canterbury, England, is a chapel where once stood the shrine of the murdered Archbishop Thomas Becket. The shrine is no longer there, but the steps which led up to it still stand, worn into hollows by the knees of countless pilgrims. For three centuries this was one of the most sacred spots in Christendom, and streams of religious pilgrims constantly thronged the road from London to Canterbury, jogging along at the leisurely pace which we call a "canter," and beguiling the time with such pleasant stories as Chaucer has preserved for us in his 'Canterbury Tales'.

The saint at whose shrine they came to worship was a London merchant's son, who had first risen to be chancellor, chief minister, and bosom friend of King Henry II. Thomas was 15 years older than his royal master, but had endeared himself by his love of fun and sport no less than by his sagacity in matters of state. The tall dark handsome Thomas, who loved splendid clothes and lavish living, must have been a striking contrast to the freckled red-haired sturdy king; but the two became inseparable, working and hunting and romping together like two schoolboys.

But this friendship was soon to turn to the bitterest enmity. Wishing to bring the church under the power of the state, Henry appointed his boon companion to the highest church office in England, that of Archbishop of Canterbury. Thomas stoutly protested, for

he had been the pupil of the former Archbishop, and he knew that in that office he would be forced to resist the king's attempts to weaken the church's power.

But Henry blindly persisted, and Thomas straightway, from the gayest of the gay, became a devout and jealous defender of the privileges of the church. The clash was not long in coming. The burning question of the time was whether churchmen should be subject to the king and his courts, or only to the Pope and the ecclesiastical courts. Unfortunately this "benefit of clergy," as it was called, extended not only to priests but to everyone who had ever received the "tonsure"; it thus permitted many persons who were practically laymen to escape due punishment for their misdeeds, for the church law forbade the death penalty.

Becket boldly stood out against Henry when he tried to lessen the independence of the clergy, and a furious quarrel began. One stormy night Becket fled in disguise to the court of Henry's enemy, the King of France. Henry seized Becket's revenues and exiled his relatives, but after several years a peace was patched up and Becket was allowed to return to England. His first act was to excommunicate those who had illegally, as he believed, executed the king's commands in his absence. This fresh act of defiance stung the quick-tempered monarch to fury.

"My subjects are sluggards, men of no spirit," he cried. "They keep no faith with their lord; they allow me to be made the laughing-stock of a low-born clerk!"

So, four of the king's knights, hearing these words, took passage hastily across the Channel—for the king was in Normandy—proceeded to Canterbury, and slew the archbishop with their swords on the altar-steps of his own cathedral.

This savage deed shocked all the Christian world. Henry was forced by the Pope to do bitter penance, and the dead archbishop was regarded as a martyr. The Pope declared him a saint, and his shrine remained the most hallowed spot in England until the Reformation, when it was destroyed by Henry VIII.

MRS. BUMBLE TALKS OF HER FAMILY



IF YOU listen real close you can hear Mrs. Bumble-Bee in the picture over the page talking as she works. She is saying something like this:

"Far be it from me to boast, but really, we Bumble-Bees and Honey-Bees and our cousins the Wasps are one of the cleverest and most distinguished families of the insect world. Everybody knows about the Honey-Bee and its remarkable work, but my branch of the family isn't so well known. Of course, the Bumble-Bees don't do as much business as the Honey-Bees, but they are important pollen carriers for plants that the Honey-Bees can't serve because their tongues are too short to reach the nectar. Our services are particularly valuable to growers of red clover. By the way, did you ever hear the conundrum: "Why does red clover grow thickest where there are cats?" The great Charles Darwin first pointed out that this is true because the cats kill the field-mice, which would otherwise destroy the homes and nests of the Bumble-Bees.

"Just above the Honey-Bee and to your left, the Leaf-Cutter Bee is cutting out a rose leaf for one of her honey jars. She uses her mandibles much as you use the scissors in paper cutting, holding the leaf with her six legs, three on each side. She bites toward herself so that the piece cut off remains in the grip of her legs. When it is about to fall off she flies with a triumphant buzz straight as an arrow to the mouth of a little tunnel she has prepared in a decaying branch of some tree. With these leaves she makes little honey jars in the tunnel, fills them with honey and pollen, lays an egg in each, and then puts on the cover. When an egg hatches, there is the jar of honey all ready for the baby, and he's right in the jar!

"The nest of the Wasp is quite different but no less remarkable. It is hidden underground, usually in some wayside bank. All the Wasps but the Queen die off in the Fall and the Queen Wasp starts a new colony. Finding a hole in a bank—preferably the deserted burrow of a field-mouse—she cleans it out, then makes a wood pulp from the fibers she gnaws from weathered wood and forms three cup-shaped cells at the end of a pillar of this pulp hanging from the roof, lays an egg in each, and then roofs all of them over. Then she adds more cells. While the first eggs have been hatching into tiny hungry grubs, she has gone on building more cells, and what with feeding the grubs as they come along and building more cells, she is kept pretty busy, I can tell you! As soon as the young Wasps are strong enough, though, they take over the nest-building and the feeding, and the Queen devotes all her time to laying eggs."

THE BUSY BEES AND THEIR COUSINS



Lovely morning, isn't it? And how the bees and their cousins the wasps are enjoying it! They've been up since daybreak, and it's going to be another busy day with them. Down in the right-hand corner the Honey-Bee is working away on a head of white clover. The Leaf Cutter is cutting out a rose leaf. Above her is a Green Bee going somewhere in a great hurry. And the Bumblebees are reaching out their long tongues, as usual, into the red clover blossoms. In the air on the left are two Bumblebee workers. The society name of the one in the striped suit is *Bombus Philadelphicus*. The one in the brown suit is better known to most people as the Ground Bumblebee, though scientists call it *Bombus Ternarius*. The one on the clover head with her back toward you is a *Philadelphicus* Queen. Below her, on the left, is a Ground Bumblebee Queen, and coming toward her in the yellow suit you recognize another *Philadelphicus* worker. Above and to the right of the Green Bee is a Yellow jacket looking for a meal, and just above her are two solitary or Thread-Waisted Wasps. The gaily painted fellow with the spidery legs is the Golden Digger.

In the WORKSHOP of the BEES

BEE. As an architect, the bee—especially the honey-bee—is not surpassed by any member of the animal kingdom except man. The structure of a honeycomb is perfection in the way of strength and space for holding fluid contents. Maurice Maeterlinck, the renowned Belgian poet, whose 'The Life of the Bee' is one of the most interesting books in literature, thus describes the inside as it would look to us if we could see it through the eyes of the bee:

"From the height of a dome more colossal than that of Saint Peter's at Rome, waxen walls descend to the ground, gigantic and manifold, vertical and parallel geometric constructions, to which, for relative precision, audacity, and vastness, no human structure is comparable. Each of

these walls contains thousands of cells that are stored with provisions to feed the whole people for several weeks. In the center there stands the royal domain of the brood-cells, set apart for the queen and her attendants—about 10,000 cells wherein the eggs repose, 15,000 or 16,000 chambers tenanted by larvae, 40,000 dwellings inhabited by white nymphs to whom thousands of nurses minister. And finally, in the holy of holies of these parts, are the three, four, six, or twelve sealed palaces, vast in size compared with the others, where the adolescent princesses lie, who await their hour, wrapped in a kind of shroud, all of them motionless and pale, and fed in the darkness."

Wonderful structures

IN all the wonder-book of nature there is no story more amazing, more fascinating, more instructive, than the life-history of the bee. Wise men have been studying this mysterious little insect for centuries, but we still have much to learn about it. The skill, the ingenuity, the devotion of the bee are marvels that astonish us the more, the better we come to know them.



In this highly magnified view of a bee you see how the sensitive feelers grow out of the middle of the face. Beneath the head are the delicate mouth parts making up the proboscis, which is usually folded back beneath the head. In the center of the proboscis is the slender flexible grooved tongue with which the bee gathers nectar.

like this can of course be made only by highly developed communities, such as are formed by the honey-bees. Honey-bees and bumblebees are called the *social* bees, because they live all their lives in great colonies containing sometimes in the case of honey-bees as many as 50,000 individuals. All the other families of bees, which nest by themselves, are called *solitary* bees. Each mother of these species provides a nest for her young, which no longer live together when they have grown to adults.

The honey-bees which we see flitting from flower to flower in garden and meadow have the most complicated social organization of all the animals, with the possible exception of the ants. They live in a republic where the citizens do all the governing

without voting, where the many kings are powerless, and the one much cherished queen works as hard as

any of her subjects, and longer. Honey-bees are perfect socialists; they labor without competition or personal reward, and they have everything in common. They are divided into castes, as workers, queens, and drones, but these castes exist for the benefit of all, not for their own private advantage.

Where the Females Do the Work

The worker honey-bee is a female specially undeveloped and specially changed physically to carry on the labors of the colony. Her brain is much larger than that of the queen's or the drone's. She has combs on her hind legs to collect the pollen from

A QUEEN AND HER ATTENDANTS



A queen and her attendants are just taking possession of a row of cells in a new hive. The queen is preparing to lay an egg in one of the cells, while the members of her escort encircle her, prepared to feed her or assist her in every way.

contained in the Easy Reference Fact-Index at the end of this work

flowers, and baskets to store it in. She has a system of chemical laboratories within herself, in one of which she changes the nectar of the flowers to honey. In another she produces food for queens, and in another she changes honey into wax. The duties of the worker bee are many. When she first matures she has to feed the little bee grubs or *larvae*, and keep the hive clean and ventilate it by fanning it with her wings. Later she learns how to take wax and build it into a honeycomb—or to hang up claw in

claw with her sisters and gorge with honey in order to give forth little scales of wax from the glands on the lower side of her abdomen. She gathers nectar from the flowers, changes it to honey, and then stores it in the honeycomb. She gathers pollen, bringing it home in her pollen basket and then scraping it off into a cell, where she tamps it down with her head to make it into solid "bee-bread" to be fed to young bees. If the colony is attacked she must join in the battle to defend it. She may have to help exile her drone brothers when the time comes to get rid of them; or she may be waiting-maid to the queen, feeding and caring for her tenderly and producing from her own glands the rich food necessary to the royal mother. She may have to gather bee-glue from leaf buds to calk the crevices of the hive, or she may have to hunt a suitable new place for housing a swarm that is soon to come out.

Whatever her duties, she works with all her might and without any consideration for herself. She will starve herself to feed the queen; she will fight any enemy with the utmost recklessness; she will work at bringing in food until her frayed wings can no longer carry her; and

at the end of her short and laborious life she falls by the wayside to die, neither expecting nor desiring any help from her sisters. There is no gratitude or pensioning in the bee colony; death and oblivion is

the fate of the most ardent workers when they fail. The individual is nothing; the community is everything.

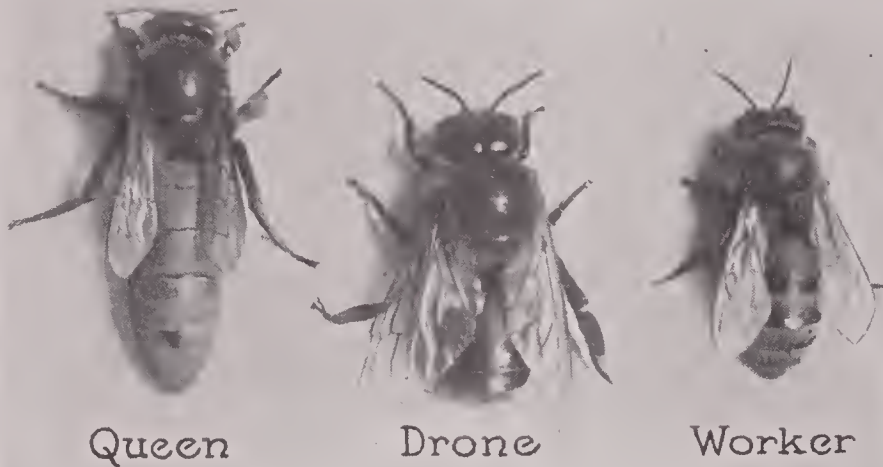
The worker is hatched as a little whitish grub from a fertilized egg placed by the queen in a small cell of the honeycomb. For six days after she hatches she is fed by the bee

nurses. Then her cell is capped, and she eats the food provided and makes a delicate silken cocoon for herself and changes to a pupa. Twenty-one days from the time the egg was laid the worker bee comes forth, ready to begin her labors.

The queen comes from an egg that would ordinarily develop into a worker. The workers start large cells at the edges or depressions of the comb, and deposit an egg in each. As soon as an egg hatches, they feed the larva on "royal jelly," a very rich food which

they produce. This food has a wonderful effect upon the young larva in many ways; for, 16 days after the egg is laid, the royal grub has matured and comes forth a queen bee, larger than a worker and with a long graceful body. The workers anxiously attend to her every want. Her first act after she comes out of the cell is to run over the comb and sting to death any other queen or tear down the cell of any grub "princess" that she

can find. If two queens mature at the same time they battle until one is killed, fighting with a royal weapon—a sting curved like a scimitar—which the queen never uses upon anything or anybody except her rivals.

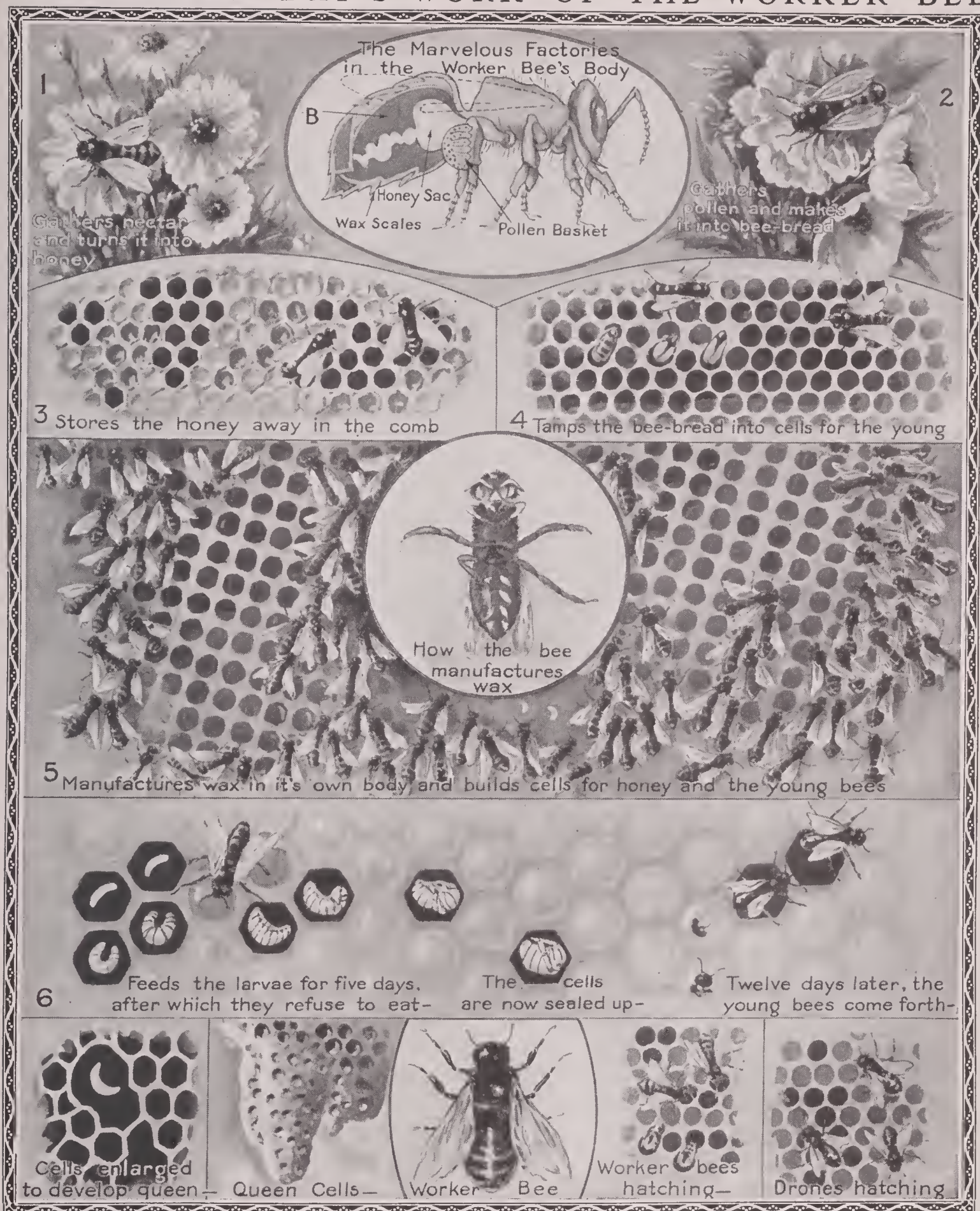


A worker just returned from "marketing" in the fields, with the pollen basket on the hind leg as full as it can be.



Bumblebees keep their honey, not in little wax cells as the honey-bee does, but in round cells clustered together in the disorderly way you see here. These honey pots are built in the abandoned homes of field-mice or in any other rude shelter on the ground.

ALL IN THE DAY'S WORK OF THE WORKER BEE



Here you have the life of the bee in pictures. The pictures from 1 to 5 show you the gathering, manufacturing, and storing of honey and bee-bread, the making of wax, and the building of the comb. Section 6 is a picture-biography of the bee, from the time it begins as a tiny white egg until it comes out all dressed up in its new wings. At the bottom are views in different parts of the hive, with a picture of the wonderful insect that does all these marvelous things.

But the picture you should examine most carefully is the one in the middle at the top. This shows the mechanism with which a bee performs all its amazing tasks. The bee's stomach (B) is a chemical laboratory in which is concealed a very mysterious power. After the nectar from the flowers has been turned into honey, the bee swallows it, and it passes into the honey sac. A human chemist couldn't turn honey into wax if he worked for a year, but a bee's stomach does this work easily and rapidly while the bee, after it has swallowed all the honey it can hold, hangs by its tiny feet to the roof of the hive. The wax then comes out through the wax scales on the under side of its abdomen, and the bee scrapes it off with its hind feet, as you see in the circular picture in the center.

contained in the Easy Reference Fact-Index at the end of this work

After a time, on some sunny day, the queen will fly from the hive seeking her mate. After mating she returns alone to the hive, capable of laying fertilized or unfertilized eggs at will. The fertilized eggs develop into workers and queens, the unfertilized into drones. She soon commences her great work of egg-laying, thrusting her abdomen into cell after cell and leaving an egg glued at the bottom of each. When the honey season is at its height, she sometimes lays six eggs a minute, or 3,000 in a day—twice her own weight. When the honey harvest runs low she lays fewer eggs; whether this is the result of her own wonderful instinct or whether it is in response to the food given her by the workers, no one knows. The queen may live five years or longer, while the worker, in the busy season, may wear herself out in three weeks.

The Life of the Drones

The drone or male bee has the least fortunate lot of all the bee citizens. In order that one drone may fulfill his destiny of mating with the queen, many are born only to be slain when the food supply runs low. The luckless drone is denied a share in all activities in the community. He is a clumsy broad blunt-ended bee, fitted for a life of idleness. He has no pollen baskets on his legs, no wax glands or honey stomach in his body; worst of all he has no sting to protect himself, and his tongue is not long enough to reach nectar in the flowers. But his wings are large and strong, to carry him miles in search of a queen; he has very large eyes—with 26,000 facets—and his antennae are fitted with smelling glands so that he has more than 37,000 tiny nostrils wherewith it is said he detects the fragrance of his mistress' royal person.

The drone is hatched from an unfertilized egg laid in a cell larger than that of the worker. He is at first fed on rich food of pollen and honey. Twenty-four days from the laying of the egg he cuts a circular lid in the cap which the workers have made over his cell and crawls out, to move about on the comb and eat his fill of honey. After about two weeks he begins making flights hunting for a queen; but when he finds her his happiness is brief, for he dies immediately after mating. If he finds no queen consort, his lot must puzzle him; for his sister workers, so kind to him always before, on a day when the food supply is limited,

hunt and harry him fiercely, driving him outside to perish.

How Bee Colonies Spread

Bee colonies spread by swarming. A young queen is reared early in the season. Usually before she emerges from her cell, the old queen, followed by a large number of workers, departs for another abode, which, unless controlled by man, is some place selected by a worker scout. Those left behind are mainly young workers.

The products of the honey-bee are honey and beeswax, the honey being marketed either in the comb or extracted and

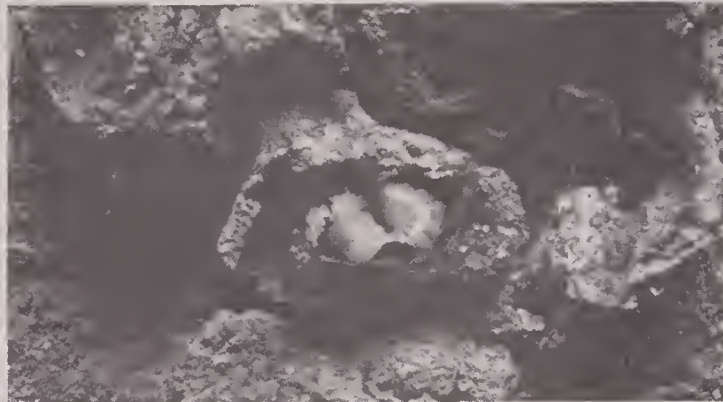
bottled. The beeswax remains when the honey is extracted from the comb. Honey is the most healthful of sweets and before the 17th century was the only generally used substance for sweetening food. Bee-keeping is a profitable business; a strong colony sometimes produces in one season 500 pounds more honey than it uses. However, it is a business that requires training, skill, and constant watchfulness, in part because bees are subject to serious diseases. Owners of orchards realize the value of bees in carrying the pollen of fruit blossoms and find it profitable to keep bees for that purpose, entirely apart from the value of their honey.

In favorable seasons bees do not go more than two miles from the hive in searching for nectar. Basswood, white clover, in the North, and sage and orange blossoms in the South and West, yield the best quality of honey; buckwheat honey is dark and brings a low price.

There are no honey-bees native to America north of Mexico. Our wild honey-bees are colonies that have escaped from apiaries (places where bees are kept) and have found homes for themselves in hollow trees. The first bees brought over were the German or black bees. The Italian bees, which are more gentle and have longer tongues, have become universal favorites. Cyprian bees, Syrians, Egyptians, and Carniolans are races that have been introduced here and have found favor with a few.

The bumblebees are also social, but they have not reached the efficiency of the honey-bee. However, they are very important as pollen carriers for thousands of plants, because they have long tongues and so are able to take nectar from deep flowers which

A PEEP INTO THE NEST OF A MASON BEE



The cell or nest of the Mason Bee is made of clay. In it the mother bee lays her egg which hatches into the larva shown here.

A SWARM



Somewhere in the center of this living mass of bees is an old queen, driven from the hive by jealousy. Around her, hanging to each other by their claws, are her faithful workers.

the honey-bee cannot reach. This fact has proven very important to growers of red clover, for only the bumblebee can reach the nectar and thus carry the pollen for this important plant. The sight of a bumblebee should warm the heart of every lover of flowers, and bumblebees should be protected by law.

In early spring we often see a great bumblebee queen or mother flying low over the freshening meadows, hunting for the deserted nest of a field mouse or some other suitable cavity for a home. Finding a cozy place, she toils early and late gathering pollen and nectar from all flowers in bloom. This she mixes into an irregular mass of solid "bee-bread," upon which she lays a few eggs, gradually adding to the pollen mass until the first brood is hatched.

The little bee grub as soon as it is hatched, burrows into the bee-bread, making a little cave for itself as it eats. After it is fully grown it spins a silken cocoon about itself, and later comes out a worker bumblebee. She and her sisters at once set about gathering pollen and nectar, thus relieving the queen mother from the work of providing food, so that she can give all her energies to the sole

The queens are the only members of the whole colony of hundreds of workers and drones that are strong enough to stand the cold of winter. Thus each bumblebee colony lasts only for one season, while the honey-bees pass the winter in a semi-dormant state.

The hairy body of the bumblebee is of great use in brushing and holding the pollen when she is working on flowers. After she is well powdered she alights on some leaf, and with the most strenuous and comical efforts combs the pollen out of her fur with special combs on her legs, and packs it in her pollen baskets on her hind legs. There are many species of bumblebees, some large and other small; but whatever their size they are all beneficent friends of the flowers.

"Trades" among the Bee People

Among the most common of the *solitary* bees are the carpenters, the leaf-cutters, and the miners. The mother carpenter bee bores a tunnel in soft dead wood by cutting out the chips with her jaws. The tunnel leads straight in for a short distance and then downward, and it is just large enough for her to move in comfortably. After the tunnel is completed she gathers pollen and nectar from flowers, and mixes them into a ball. Then she lays an egg upon this pollen mass. Next she gathers some of the chips cut out in making the tunnel and glues them together with saliva, making a little partition above the pollen mass. This acts as a floor for the next cell, in which she places another pollen ball and another egg. She thus makes several cells, in each of which a young bee hatches from the egg and develops to maturity upon

THE CARPENTER BEE'S APARTMENT

The many-storied apartment houses, which the Carpenter bees dig in the trunks and branches of trees, would look like this if you cut the wood away. On the top floor the mother bee is preparing a mass of bee-bread and honey. In this ready-to-eat loaf she lays her egg, and the loaf serves both as a cradle and a pantry for her infant when it hatches. On the floor below is an egg, laid, perhaps, the day before, and protected by a partition of chewed-up wood pulp as firm as plaster. Below that a grub has hatched out and is eating its bread and honey. On the two lower floors the young bees have reached the chrysalis or "sleeping" stage, during which their legs and wings develop. They will soon be ready to come out, but will have to wait until their youngest sister on the top floor matures. Then each tenant will bite a hole in her own ceiling and all will march out at once through the roof, and the one that hatched from the first egg laid is always the last one to leave the nest.

duty of laying eggs. These daughters tend the growing family with the most devoted care, and later strengthen the silken cocoon cradles with wax, making them into cells in which they store honey. Late in the season a few queens are developed from the eggs laid by the queen, and a few drones to be mates for the queens.

the "bee-bread" she has provided. When they are fully grown each young bee tears down the partition above him, and they all come out into the world in single file, the youngest first.

Not all carpenter bees bore into solid wood, for many species bore out the pith in the dead twigs of sumac, elder, raspberry, and other bushes. Some

carpenter bees are leaf-cutters also, lining their nests with pieces cut out of leaves, especially rose leaves, and making the partition above the cell with circular pieces cut from the same leaf. Leaf-cutter bees are very clever in saving themselves the trouble of boring out a nest, and often use crevices between the shingles or even the holes in awning rods. Some especially dainty species line their nests with pieces cut from the petals of pansies and other flowers. These carpenter and leaf-cutter bees vary in size from that of a small bumblebee to a tiny creature scarcely a quarter of an inch in length.

The miners bore their tunnels into the ground instead of into wood, and make tiny cells branching off the main tunnel to receive the eggs. The walls of the cells are glazed so that they look like the inside of an earthen jug. In each cell is stored pollen and nectar paste; then an egg is laid and the cell closed until the pupa is grown up and pushes out. While each mother miner digs her own nest, many of them may live as neighbors in villages. Sometimes a square rod of ground will include thousands of burrows. Some of the miners are as large as honeybees, but one species of miner is the smallest of all bees—less than a quarter of an inch in length. These tiniest of bees usually mine in the face of cliffs or sandbanks, which look as if they had received a charge from a shotgun.

The carpenter and

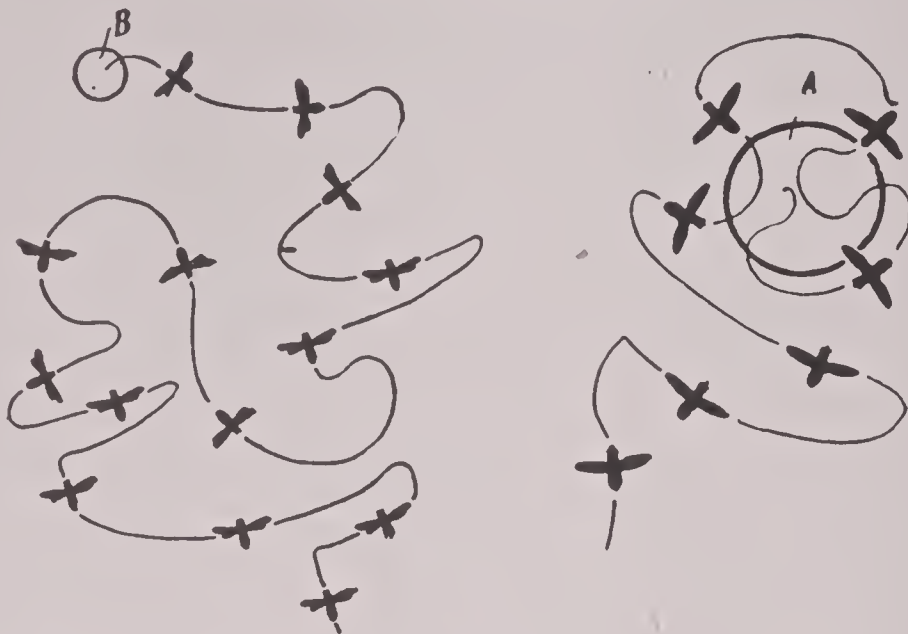
mining bees do a very important work in carrying pollen from flower to flower in the early spring, thus providing for their reproduction. Among the solitary bees some called *inquilines* are loafers and sponge

their living in the nests of other bees, just as the cowbird does in the nests of other birds. But no creature can become a parasite and get off without punishment. These lazy bees have degenerated in form and have lost all power to live independently.

Bees constitute the superfamily *Apoidae* of the order *Hymenoptera*, which includes the ants and wasps. About 1,500 species are recognized. The hive bees constitute the family *Apidae*; scientific name of common honey-bee, *Apis mellifica*. Bum-

blebees belong to the family *Bombidae*. The bee has four wings, the hind pair the smaller; its mouth parts are fitted for biting and sucking, and the basal segment of the foot is broadened and fitted for carrying pollen from flowers. The young of all bees are grublike.

THE PUZZLE OF A BEE'S FLIGHT



Perhaps you have noticed the extraordinary skill of many insects in whirling and darting and swooping through the air. How they steer themselves so deftly in their sudden turns is still a mystery to science. Here we see (B) the typical course of a bee approaching a blossom, and (A) the twisting path of the drone fly. When the bee has taken on its load of pollen and honey, however, it returns to the hive in a path so straight that we use the expression "bee-line" for the most direct route possible.

BEECH TREE, BEECH LEAVES, AND BEECH NUT



On the left is a fine beech tree with its smooth, light gray bark. On the right are the leaves, the burrs, and two of the toothsome kernels, lying on a screen of inch-squares to show their size. Beechnuts not only delight boys and girls, deer and squirrels, but contain a valuable oil.

BEECH. The stately beech tree grows for 50 years before it bears its peculiar pyramid-shaped nuts, but it makes a beautiful shade tree much earlier. The life of the tree is about 250 years. The American beech (*Fagus americana*) grows to be 80 feet high or more, and about 3½ feet in diameter. It has a smooth light-gray bark, a broad rounded top, and serrated leaves that turn yellow and brown in autumn. The European beech (*Fagus sylvatica*) often grows 100 feet high or more, and has dark-gray bark and shining leaves which remain

on the tree most of the winter. The beautiful beeches of England have long been famous, as are the beech forests of Denmark and Germany. One of the most beautiful varieties is the copper beech, which is native to Europe, distinguished by its red sap and leaves.

Beechnuts with other "mast" or forest nuts supply pasturage for deer and swine, and boys and girls can testify to the toothsome-ness of the tiny kernels. Beechnut oil is sometimes used in Europe for cooking, salad dressing, and lighting. The wood is hard for water to penetrate and hence is used in France for making wooden shoes. It is also much used for flooring and building timber, and for charcoal, and is distilled to make the finest kind of creosote for medicinal use (see Creosote).

BEET. It was said of Napoleon that he would go down in history with a sugar beet in one hand and the Code Napoleon in the other. It is true that the great emperor did much to encourage beet-growing, because of England's practical monopoly of the colonies which produced sugar cane; but we are chiefly indebted for our temperate-zone sugar production to the scientists of the 19th century, who developed the beet from a root producing only seven per cent sugar to one which is almost one-fifth sugar, and who are still working to improve the sugar content by seed selection. This remarkable advance in the last 50 years provides an admirable illustration of what can be done by applying scientific methods to agriculture. (See Sugar.)

Besides the sugar beet, which is usually whitish or yellowish, several other species are cultivated. Of these the garden beet is the best known, with its red root and rather small top. Chard (also called Swiss chard) has tall tops with large succulent leaf stems which are cooked and eaten somewhat like asparagus. Mangels, or "mangel-wurzels," are very large varieties of beet grown for stock feeding. Foliage beets, which have beautifully colored leaves, make excellent borders in garden beds.

The beet (*Beta vulgaris*) belongs to the family *Chenopodiaceae*. It is mostly biennial. It is found growing wild in sandy soil around the Mediterranean, and has been culti-

vated for about 2,000 years. Like all root crops, the beet needs a loose, light, rich soil, which must be in the best condition of tillage.

BEETHOVEN (*bā'tō-vén*), **LUDWIG VAN** (1770-1827). Suffering and success play equal parts in the life of the great musician Beethoven. The story begins with tears, for at the age of four—to satisfy a selfish father—wearry, hungry, and cold, he was forced to spend hours at the violin and clavier (an early form of the piano). It reaches a double climax in the episode of the memorable concert, when, after the

performance of his two greatest compositions, the total deafness of the great master made it necessary that he be turned to the audience to see the overwhelming storm of applause accorded him. It closes with a great funeral-pageant, in sad contrast to the death-bed scene in which the lonely artist passed away, his longing for intimate companionship unsatisfied.

Beethoven, while credited to the German nation, was of Dutch stock. His grandfather had removed his family from Antwerp to Bonn (Germany) 32 years before the birth of this famous musician.

Beethoven's family life was always miserable. The meagerness of the father's income as a singer and his intemperate habits kept the household always in need. The father planned to make of his son a child musician whose concert performances would fill the empty family purse. But with all his faults, the father must be credited with having given his son the best instruction he could procure for him. When 9 years old Ludwig was the pupil of the court organist of Bonn; when 11 he made his first concert tour; when 13 he became assistant court organist.

When Beethoven was but 15, the increasing incompetence of the father and the ill health of the mother made it necessary for him to take entire charge of the large family. In spite of these trying circumstances, the boy made such progress in his art that his friends, impressed by his genius, made it possible for him to take up his residence in Vienna, then the world's musical center, and the city in which he spent the remainder of his life. Here Beethoven's

BEETHOVEN AND THE THUNDER OF THE GUNS



Dread of the deafness which finally afflicted him overshadowed all Beethoven's life. During the siege of Vienna by Napoleon, he retreated to a cellar where he tried to shut out the sound of the guns lest they should destroy his hearing.

brilliant playing of the clavichord (a development of the clavier) at once established him in musical circles, and his compositions were eagerly sought by publishers. He soon became the foremost musician of the day.

Ears Deaf to the Music that He Made

These should have been bright years for Beethoven, but over all the glory of his success hung the dark shadow of a great grief. In the midst of his triumphs he became totally deaf. With this affliction came periods of intense suffering, caused by some acute digestive ailment and aggravated by his highly emotional temperament. At such times he was nervous and irritable and days of deep remorse followed. At last Beethoven entirely withdrew from society. His brothers attempted to manage his business affairs, entangled him in lawsuits, and estranged him from his best friends. A nephew who had been left in his care, and on whom Beethoven lavished all the affection of his lonely life, proved a burden of sorrow and bitterness.

His habits of living, like his music, knew no rules. When composing he could endure no interruption. He worked in the greatest disorder and oblivious to the passage of time. Unsympathetic housekeepers and landlords caused frequent quarrels and changes of residence. Beethoven never knew the comfort of a real home. He was fond of the country and spent much time in the fields, wandering about, singing and muttering to himself. Though below medium height, his friends say that in moments of inspiration

his diminutive figure seemed to tower to the gigantic proportion of his mind. A letter attached to his will begged that his doctor acquaint his friends with the physical conditions under which he struggled, that they might forgive his seeming harshness, which he declared was partially caused by his hopeless longing for human intercourse and sympathy.

And Yet How Splendid the Work He Did!

Pitiful as Beethoven's isolation was, it seemed a source of inspiration. Composition after composition flowed from his pen. All forms of vocal and instrumental music—from dainty bagatelle to grand symphony, from simple songs to opera, oratorio, and mass—are included in his works, 138 in number. In all these varied forms Beethoven proved his skilful musicianship. His 38 sonatas alone would give him a foremost rank among musicians; for he took this old set established form for all instrumental music and changed it, making it express a freedom of art unimagined by his predecessors. It is his symphonies, however, that make him incontestably preëminent. Richard Wagner, writing of these nine compositions, says: "He developed the symphony to such a fascinating fullness of form, and filled this form with such an unheard-of wealth of enchanting melody, that we stand today before the Beethoven symphonies as before the boundary line of an entirely new epoch in the history of art; for with them a phenomenon has appeared in the world, with which the art of no time and no nation has had anything even remotely to compare."



The ARMORED BANDITS of the INSECT WORLD

Protected Like the Knights of Old, These Doughty Fighters are Continually Engaged in a Ruthless Warfare. As Weight-Lifters, Wrestlers, and Acrobats They are the Olympic Champions of the Six-Legged Tribes

BEETLES. Few members of the insect world are better fitted for the rough and tumble of everyday life than those bold, blundering, hungry freebooters—the beetles. Nearly all of them are covered from head to foot with strong tough armor-plate, which is their skeleton worn on the outside. And in addition to this great advantage, they have drawn on nearly all the rest of Nature's bag of tricks for their protection and support.

Indeed, if a contest of strength and skill were held among insects, the beetles would undoubtedly carry off the prize for all-around excellence. There are powerful flyers, strong jumpers, fine climbers, and swift runners among them; some excel in digging and

boring, swimming and diving; and as weight-lifters, wrestlers, and acrobats, they number in their ranks the unquestioned champions of the six-legged tribes.

On the other hand, beetles are very poor singers, few of them possessing a voice at all, and most of those have only a feeble note. As if to make up for this, some of them, like the fireflies, have the extraordinary power of giving off bright light in the dark.

But it is the armor of the beetles that chiefly distinguishes them. As you know, it is a distinguishing trait of most of the insects to have four wings, like butterflies, moths, bees, wasps, etc. In the case of the house-fly and other true flies, the hind pair of wings has been lost. In the beetles, on the

THE BEETLE CIRCUS DOWN BY THE POND



Several distinguished members of the Beetle family have accepted the artist's invitation to show off their tricks. Two Wasps, who weren't asked to come at all, are flying around at the top, but you can't blame them, for that pair of tumble-bugs with their huge ball would make anyone stop and look. If they caught sight of that beetle just coming down the tree, they would rush away home, for that is a Wasp's-nest beetle, which lays its eggs near wasp holes and whose young devour the wasp grub. Walking up the tree is a Timberman and a larger long-horned Musk-beetle. At the foot of the tree a Hercules-beetle is watching a fierce group of Golden Ground beetles attacking an earthworm. Behind him is an Oil-beetle. Arriving on the wing at the extreme left is a Blister-beetle. Below the Blister-beetle appears a member of the scarab family, and beneath him the curious Caliper-beetle is just thrusting his head into the picture. The spotted fellow in the middle is the cruel Tiger-beetle on the lookout for prey. The big black Three-horned beetle is next, and below are the Rhinoceros-beetle and the Elephant-beetle. In the pond are two Diving-beetles, while a third has come out to try his wings.

contained in the Easy Reference Fact-Index at the end of this work

other hand, something has happened to the front pair: they have turned hard and thick, folding down over the back and forming part of the creature's armor-plate. These front wings, or "wing-covers" as they are called, are not used for flying, but are raised on high to permit the filmy delicate hind wings to spread out when the beetle wants to take an air trip. Then when it alights again, the hind wings fold up, the armored wing-covers fall into place over them, and you would never know that the beetle was ever meant for anything except running, climbing, or swimming.

How the Beetles Got Their Name

It is from this peculiarity that the beetles get their scientific name *Coleoptera*, which means "sheath-winged." Another of their qualities is suggested by their English name, which comes from the Anglo-Saxon word *bitel*, meaning "the biting one." Most beetles are indeed great biters, having strong jaws which some use for killing living prey, some for devouring trees and plants, others for gnawing timber, leather, fur cloth, books, etc., and others for tearing apart the dead things or refuse on which they feed.

In battle, beetles are honest fighters using no stings or poison fangs, but grappling boldly "catch-as-catch-can" with jaws and claws. So, despite the fact that many beetles look fierce and dangerous, you may pick them up without fear, provided you dodge their "pincers" and don't mind the unpleasant smells many of them can create when frightened or angered. For this reason, and also because they are not easily injured by handling, beetles make the most interesting of insect "pets." If they are provided with their natural surroundings and their proper food, most of them quickly adjust themselves to life in a cage and show off their strange habits freely.

Because beetles have so admirably adjusted themselves to nearly all conditions of life, in nearly all parts of the world, the number of their species is believed to be greater than that of any other insect group, with the possible exception of the flies. Scientists have already classified more than 100,000 different kinds of beetles and more are added to the list every year.

THE BEETLE AND THE GYPSY MOTH



This is the *Calosoma* beetle that was specially imported from Europe to help get rid of the Gypsy Moth. Here we see him about to dine on a Gypsy Moth caterpillar.



This is a group of the eggs of this beetle. They are buried in the ground. About a week later out come the young larvae, all ready to eat the larvae of the Gypsy Moth.



These are the larvae of the beetle. Just as soon as they emerge from the ground they are able to climb trees and begin attacking the caterpillars that destroy our vegetation.



When full-fed the beetle larvae burrow into the earth and change to pupae, like this one. In a short time they assume the adult form and remain in the ground until the next season.

The life-cycle of all beetles has a complete metamorphosis, that is the beetle egg turns first into a grub or *larva*, then into a *pupa*, then into a full-grown insect (see Insects). Beetle larvae, which are usually soft-bodied and often wormlike, with hard heads and strong jaws, are usually very active and often more fierce and greedy than the grown-ups.

The smallest beetles are the "feather-wings," no larger than the head of a pin; the largest are the

African "goliaths" and the "elephant-beetles" of the West Indies, which reach six and seven inches in length and are the giants of the insect world. Between these two extremes are found beetles of all shapes and sizes, long and slim, short and fat, and with all the colors of the rainbow. Out of their immense number it will be possible to mention only a few of those which are remarkable for some trick or habit or some curious formation.

A Fierce Hungry Fellow

Perhaps the most interesting and handsome are the "tiger-beetles," wonderfully graceful and active insects with long slender legs for swift running, and colored with brilliant metallic greens and blues, sometimes marked with stripes or spots. They are fierce bloodthirsty creatures an inch or more in length, always on the lookout to pounce on some fellow insect and devour it. The tiger-beetle grubs have a strange way of trapping prey. They lie in holes in the ground, with their large ugly heads blocking the entrance. When an unwary insect steps upon its head, the grub drops suddenly to the bottom of the hole, and the victim tumbles after, to be seized and devoured.

But there's a much smaller beetle called the "bombardier," which has a way of making the hungry "tiger" look very foolish. Just as the latter's jaws are about to close upon it, the bombardier fires a little cloud of acrid irritating vapor from the rear of its abdomen. If once isn't enough to discourage the pursuer, the discharge may be repeated several times in succession, each accompanied by a faint "pop." Thus we see that "poison gas" in warfare is not so novel after all.

The Tumble-Bugs that Sleep with Kings

In contrast to the savage tiger-beetles are those peaceful, lumbering good-

LIFE HISTORY OF THE DEVIL'S COACH-HORSE

This fierce little creature belongs to the Rove-beetle family, distinguished by short wing covers, beneath which the wings are folded with amazing ingenuity. At the top the larva is burrowing in the ground and in the second picture it is enlarging its resting chamber. Next we see it transformed into a pupa, and lying beneath its cast skin. Then the pupa changes into the adult beetle, which crawls out and dries its new wings in the sun. Now it tucks its wings away under the wing-covers, and, in the sixth picture, turns its head quickly as it scents danger. As the enemy draws near, it tries to frighten it away by curling up its tail in the most threatening manner. This is pure bluff, for it has no weapons on its tail, and when the enemy—a bit of straw—comes close, it pounces upon it and seizes it in its jaws. The last picture shows the determined little fighter clinging like a bull-dog, when the straw is lifted.

natured members of the "scarab" family—perhaps the most famous of all the beetles, because their ancestors were held sacred by the ancient Egyptians, who buried them with their mummies and carved rare stones and gems in their likeness.

One of the scarabs, however, wears a clown's costume, and we call it a "tumble-bug" and a "dung-beetle." And a most interesting clown it is, too, as it carves out a mass of dung bigger than itself and rolls it into a perfect ball, then stands on its head with its hind legs up on the ball and pushes it along backwards. Up hill and down it goes, stumbling and kicking, crawling around and under its treasure, lifting it over stones, pulling it out of pits, until it finds a spot to suit it. There a hole is dug and into it the tumble-bug goes with its ball, remaining until it is entirely eaten. The eggs of the tumble-bug are laid in similar balls buried in the ground.

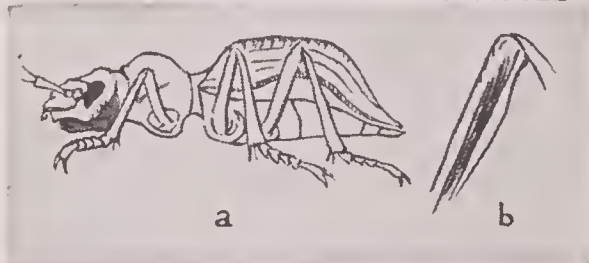
The "tumble-bug," like its cousin the "June-bug" (see June-Bug), and many other beetles, has a very hard time getting up if it falls on its back on a smooth

flat surface. There is a group of beetles, however, which has solved this difficulty admirably. They are the "click-beetles," so named because, if they are upset, they double up and then suddenly straighten out with a "click" which tosses them high into the air. Like cats, they usually land on their feet and scurry away. These acrobats are also called "skip-jacks" and "snapping-bugs." Their larvae are the "wire-worms" so destructive to farm and garden crops and fruit trees.

On the whole, the order of beetles is very harmful, for although the tiger-beetles, the ground-beetles, the lady-bugs (see Lady-Bug), and many other varieties destroy enormous numbers of plant-eating insects, and the scavenger and carrion-beetles dispose of a great quantity of decaying matter, there are far more beetles which feed upon trees, plants, fruit, grain, and other valuable foodstuffs. Among the worst offenders are the rose-chafers, the leaf-chafers, nearly all of the long-horned beetles, the dreaded potato-bugs, the tortoise-beetles, the darkling-beetles, the asparagus-beetles, those great enemies of timber, the engraver-beetles, and, most destructive of all, the countless hordes of snout-beetles or weevils (see Potato-Bug; Weevils).

It has been said that there is no animal or vegetable substance that is not preyed upon by some member of the beetle family. As an example of varied diet

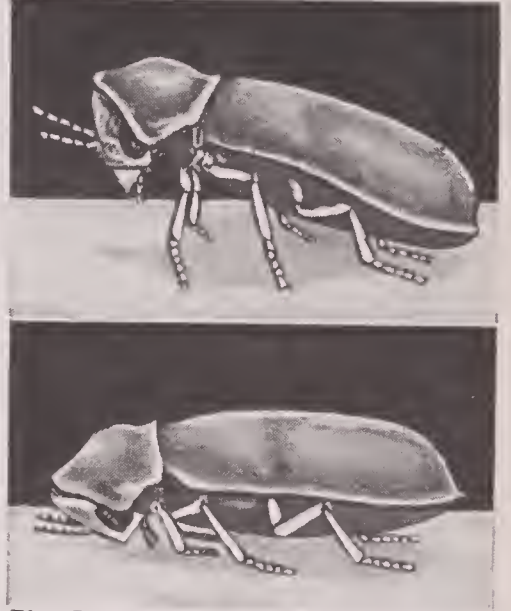
HOW MR. BEETLE PLAYS HIS FIDDLE



This beetle, by rubbing a kind of file on his wing-cover (a) with another file on his leg (b), makes a sound which, no doubt, passes for fine music in Beetledom.

consider the menu of the tiny "drug-store beetle," which not only eats any form of dry groceries, but delights in such things as red pepper and in at least 45 different drugs, including aconite, belladonna, and

THE RAP OF THE DEATH-WATCH



The Death-Watch, instead of trying to frighten people, when he makes that dreaded rap, is signaling to his lady love. Here we see this beetle much magnified, raising his head, and then bringing it down with a thud.

THE BEETLE PIRATE GETS AN UNPLEASANT SURPRISE



The big Tiger-beetle was interrupted during his dinner of snails by the arrival of two Bombardier-beetles. He made up his mind to have them for dessert, and started in pursuit. Just as his jaws were about to close upon the nearest one, something very astonishing took place. The two Bombardiers fired their little stern-guns loaded with poison gas, and the "tiger" was forced to quit the chase. This scene, reproduced from a museum group, shows how Nature occasionally plays a rare joke.

ergot—all three poisonous to man. Printed books are not too dry for it nor paraffin too oily. A near relative, the "spider-beetle," one of the varieties often called "bookworms," has a record of having "penetrated directly through 27 large volumes in so straight a line that a string could be passed through the opening and the whole series of volumes suspended." Another relative, the "cigar-beetle," dines on cigars, cigarettes, and any form of dried tobacco.

The "Death-Watch" and His Mysterious Tick

It is to this group of small beetles that the famous "death-watch" belongs. Spending its life in tunnels bored in furniture or other household timber, this creature calls to its mate by tapping its head against the sides of its corridors. This faint knocking sound was formerly believed to be a warning of impending death.

Other pests are the *dermestids* or "skin-devouring" beetles, including the "larder-beetle," which feeds on smoked meats, hides, feathers, hair, and horn; the "leather-beetle" of similar tastes; the "carpet-beetle"

or buffalo "moth," which is not a moth at all, but one of the worst foes of carpets and stuffed animals and other museum specimens.

One of the strangest of beetles is the "blister-beetle," sometimes called the "Spanish fly," for besides the fact that its body contains a substance which is used medicinally for raising blisters on the human skin, it has a most unusual life history. After the larva hatches from the egg, it does not go directly into the pupa form, but passes first through no less than five intermediate larval stages. The wingless "oil-beetles" have a similar experience, which is called by scientists *hypermetamorphosis*.

The Pirates of the Pond

Among the most interesting water-beetles are the large predacious diving beetles, so called because of their fierce and bloodthirsty disposition. Shaped like huge watermelon seeds, their smooth boat-shaped lines and paddle-shaped hind legs make them excellent swimmers, enabling them to capture and devour almost all of the smaller inhabitants of ponds, includ-

ing young fish. When at rest they float head down with the tips of their bodies sticking out of the water. In this way their *spiracles* or breathing tubes, situated at the rear of the abdomen, have access to the air. When they dive they carry down a supply of air beneath their water-tight wing-covers. Their larvae, known as "water-tigers," are even fiercer and hungrier creatures than the adults.

The "water-scavenger" beetles, sometimes one and a half inches long, may also be found in quiet pools, where they clean up decaying plant and animal matter. They carry the air they need for breathing in a thin film spread over the under side of their body, which gives them a silvery appearance when seen from beneath. Unlike the diving beetles they are highly desirable pets for an aquarium, for they keep it clean without molesting the other inmates.

The Funniest Beetles of All

The most amusing of the water-beetles are the "whirligigs," which may be seen on any body of still water dancing in rapid circles over the surface, as though gone mad. If disturbed, they make a queer squeak by rubbing the tip of their abdomen against their wing-covers. These whirligigs have split eyes, the upper half for seeing objects above the surface, the lower half for looking through the water.

A strange family of creatures called "stylops" is sometimes included in the beetle order. Only the male has wings; the female spends her entire life in the body of some other insect such as a wasp, the tip of her body projecting through the segments of her host's abdomen.

No dragons ever invented to frighten children could be stranger in appearance than the monsters of the beetle tribe. The "stag-beetle" with its great hooked mandibles, nearly as long as the insect itself, is perhaps the most startling of northern species, but the tropics have even more remarkable species, such as the "centaur-beetle" with its huge cow-like horns; the five-horned "rhinoceros-beetle"; the "hercules-beetle" with the long wicked-looking projections from its head and back used by the male in carrying its mate; and many others. Curiously enough, these freaks are nearly all the most harmless of all the beetles.

Beetles are not True Bugs

Though many beetles are popularly called "bugs," they should not be confused with the true bugs with sucking beaks, which form a distinct order of insects.

In addition to the hard wing-covers (*elytra*) which distinguish beetles from other insects, they have the first segment of the thorax, the *prothorax*, movable. To this is attached the first pair of legs, the other two pairs being fastened to the second and third segments. In certain of the running beetles the hind wings are reduced to a very small size, useless for flight, or are absent altogether, and in such cases the edges of the wing-covers are often grown together. In other species, such as the "rove-beetles," the wing-covers reach only a short way down the back, leaving the

rear of the abdomen exposed. Beetles' eyes are of the large compound variety; the simple eyes or *ocelli* being very rare among adults, even when existing in the larvae. The *antennae* or feelers are of widely various forms, sometimes broad and short, sometimes twice as long as the beetle's body. They are organs not only of touch, but of smell, and probably of hearing.

Scientific names of best known beetle families: ground-beetles, *Carabidae*; tiger-beetles, *Cicindelidae*; carrion-beetles, *Silphidae*; rove-beetles, *Staphylinidae*; glowworms, etc., *Lampyridae*; click-beetles, *Elaterridae*; water-beetles, *Hydrophilidae*; oil- and blister-beetles, *Meloidae*; stag-beetles, *Lucanidae*; scarab-beetles, *Scarabaeidae*; lady-bugs, *Coccinellidae*; weevils, *Curculionidae*.

BEGONIA. This common houseplant is cultivated for the beauty of both flowers and foliage and is easily grown from cuttings taken in the late summer and autumn. The flowers are usually large and showy, some greenhouse varieties reaching four to six inches in length, and vary in color from pink to scarlet and from white to yellow. The fleshy waxy leaves, large and variegated, are curiously unequal-sided. A winged capsule containing numerous minute seeds constitutes the fruit of the plant. The summer flowering begonia, which produces large single and double flowers, is tuberous rooted, while the winter flowering variety is fibrous rooted. Two other species are the semi-tuberous begonia, with peltate leaves, and an Asiatic variety, *Rex begonia*, with handsome striking foliage.

The begonia is native to the tropics of both hemispheres, excepting Australia. Of the 400 species, 150 are in ornamental cultivation. The flower was named in honor of Michel Begon, a French patron of botany. Family name, *Begoniaceae*.

BEL'FAST, IRELAND. As the capital of the province of Ulster, in northeastern Ireland, Belfast occupies a prominent position in Ireland today. Its inhabitants are Scotch-Irish and Protestant—descendants of Scottish and English colonists of the 17th century—and they have built up a town which, in population, manufactures, and trade, ranks first in prosperity among the cities of Ireland. It is largely the fear of economic and religious oppression from the agricultural and Catholic majority of the island that made Belfast the center of opposition to Home Rule for Ireland.

Situated on the Belfast Lough or Bay, the city has large shipyards. It is the center of the Irish linen trade and manufacture, and its rope-works and tobacco factories are the largest in Great Britain.

In appearance the city is modern. In the 16th century there was only a little fishing village where Belfast now stands, and not until the introduction of machine spinning and weaving, in the latter part of the 18th century, did it begin to thrive. It is now a city of fine churches, imposing public buildings, the seat of Queen's University and of a number of church schools. Population, about 393,000.



BRAVE and THRIFTY BELGIUM

*The Story of Her Triumphant
Struggle Between the Warring
Nations and the Hungry Sea*

BELGIUM. A triangular-shaped land,—with the long side lying along the French border; the base resting against Luxemburg, Germany, and the “panhandle” of Dutch Limburg; and the third side bordering on the shallow North Sea and the kingdom of the Netherlands (Holland)—such is the little kingdom of Belgium, a land which has probably played as important a part in the world’s af-

fairs, in proportion to its size, as any other country since the days of ancient Greece and Rome. During every one of the centuries which intervene since the Roman conquest, Belgium has been one of the battlegrounds of Europe. And the struggle has been not only with hostile man, but with unfriendly Nature as well. Like the fields of Holland, those of Belgium are in part the product of careful fertilization of barren sand-dunes; and dikes and windmills are still necessary to prevent constant encroachments of the hungry sea.

In this struggle with Nature the Belgians have succeeded wonderfully well. Today we find, fringing the sea, only a narrow belt of dunes whose shifting sands are overcast with clouds and enveloped in mist. Behind this bleak region lies a verdant garden in which nestle the red-roofed cottages of the peasants.

***W**HAT dreadful scenes of carnage have been enacted “in Flanders’ fields,” ever since those ancient days when Caesar first wrote of the bravery of the Belgae! Romans, Franks, and Northmen pass bloodily over the land; sturdy Flemish burghers withstand their feudal count in the tumults of the Hundred Years’ War; 200 years later Belgium groans beneath the tyranny and massacres of Spanish Philip II and his agent, the Duke of Alva; the English Marlborough and the Austrian Prince Eugene here successfully resist Louis XIV’s attempt to annex the rich provinces to France; again Belgium is the cockpit of Europe when Napoleon is overthrown at Waterloo; and when the thunders of the World War begin in 1914, betrayed Belgium feels the first fury and wins the last release from Germany’s “will to conquer.” But after all the waste of war Belgium remains a thriving happy land, a veritable hive of human industry, and a pilgrim resort for lovers of art and beauty.*

The green fields, watered by running streams and sluggish canals, are rich with harvests of wheat and rye. In some of the fields, men in coarse smocks, with their loose baggy trousers tied below the knee with a cord, are spading the ground. In others men and women kneel and patiently weed the flax; while in the streams they beat the ripened stalks to separate the fibers so that they can be spun into

linen thread. Every foot of ground is made to produce the utmost possible, and grain and sugar beets are largely cultivated. But even so Belgium is not able to supply food enough for all her people; for while its area is about equal to that of Maryland, its population is five times as large, making it one of the most densely peopled lands in Europe. There are a score of thriving cities, and a hundred little villages dot the fields; along the banks of the poplar-lined canals the peaked roofs of the cottages form an almost unbroken line, and on every side rise the innumerable towers and spires of the churches. Belgium, indeed, is richer in these monuments of medieval architecture than any other country except northern France.

Europe’s Greatest Mart

In the 14th and 15th centuries Flanders—as western Belgium was then called—was the richest part of

Europe. The little rivers, the Reye, the Yser, and the Lys, were choked with the fleets from all parts of the known world. The wharves of Ghent were piled with bales of wool from England and with casks of wine from southern France. The vast cloth hall of Ypres was crowded with eager merchants struggling

Much of the money gained from this commerce was used in building churches, but more was used in the construction of their town-halls and belfries. The people were jealous of the glories of their towns. No one spoke of being a citizen of Flanders, but he was a man of Bruges, of Ghent, or of Ypres, as the case might be.

One of the fascinating stories of history is that of the struggle of these cities to gain more privileges from their counts and dukes. One of their demands was for the right to build a belfry, from which the curfew (*couvre feu*, "cover fire") should ring each night, and the alarm bell when the town was threatened by fire or by hostile attack. Many a time during the 14th, 15th, and 16th centuries did these tocsins call the burghers to arms; for the cities were forced to defend their rights alike against the kings of France, the dukes of Burgundy, the kings of Spain, and the Holy Roman emperors. Before the long struggle was over much of their commerce was ruined and these formerly busy marts had lost their independence and political importance, but not their picturesque charm.

The present-day gateway to this garden-land of Europe is Antwerp, which in the 15th century wrested from Bruges its commercial supremacy. It lies on the winding course of the Scheldt River, 50 miles from



Belgium's own industries make it the most densely populated country in Europe and the industrial portions of France and Germany border it on each side, while the fertile fields of the Netherlands lie to the north. In the "Black Country" to the south the land rises to two thousand feet above the sea, but the northern region is mostly as flat as a table.

for the products of the Flemish looms and the handiwork of the patient lacemakers. And it is said that merchants from 17 kingdoms had settled homes in Bruges, the great northern market of Europe.

the sea, and the inhabitants of the city say that "the whole world is a ring, in which Antwerp is the diamond." South of Antwerp lies Brussels, the well-built modern capital of the kingdom. Down

BRUGES, THE "CITY OF BRIDGES"



Here is a typical view of this ancient city, the smooth waters of whose canals reflect solid old buildings and pleasant parkways. The name Bruges comes from the old German for "bridge," given to it because of the many bridges over its canals. On these canals are seen many stately swans, maintained by the city in expiation of a crime committed during a medieval revolt, the killing of a magistrate, who had a swan on his coat-of-arms.

its streets clatter the Flemish milkmaids in their wooden shoes and their huge white caps and their large gold earrings. Rough good-natured dogs draw little carts filled with shining brass and copper milk-cans. From the houses comes the hum of looms, for although Belgium has many large textile factories, much of the work is still done at home. In Brussels hundreds of women sit all day long patiently weaving in and out the threads of fine Brussels point-lace. For more than 400 years the country has been famous for its lace manufacture, not only of Brussels lace, but also of the airy Mechlin lace and the fine Valenciennes. The well-known Brussels carpets are not made in Brussels, but at Tournay, a busy town on the Scheldt, some 50 miles away to the southwest. Everyone, everywhere, seems to be busy—

except at Ostend. This is the great seaside resort, and one of the playgrounds of all Europe. But even Ostend has its industrious side, for it is the second port in the kingdom, connected by canal with the quaint old cities of Bruges and Ghent, and is the center of the Belgian fishing and oyster industry. In the World War Ostend was captured by the Germans and served as one of their main submarine bases.

THE DOGS THAT BRING THE MILK



In Belgium you don't watch for the milkman, you watch for the milkmaid with her dog-cart. The milk is brought in cans of copper and brass, from which it is dipped out into your own jug.

tion. Indeed, it is Belgium's rich mines of coal and iron—supplemented by the near-by iron ores of Luxemburg and northern France—which make her

IN THE HEART OF OLD ANTWERP



This picturesque city, one of the greatest seaports in the world, has a history reaching back to the days of the Northmen. We are here in the center of the oldest part of the city, where stands the cathedral, the largest and most beautiful Gothic church in the Netherlands. In the foreground stands a figure of the Lion of Belgium. Many of the buildings in this quarter are the ancient guild houses of medieval days. These contrast strangely with the modern structures in the right foreground.

contained in the Easy Reference Fact-Index at the end of this work

an industrial country. Even the sand of her dunes is made use of in the thriving manufacture of glass. But though rich in natural resources, this region is poor in beauty. The earth is scarred and disfigured by the refuse from the mines. The villages, stretching over a gray country, are lost behind mountains of coal ash, or crouch beside the towering chimneys of hugh factories. Even the people are different from those in the northern half of Belgium, and they speak a different language. They are known as "Walloons," and their speech is a dialect of the French; while about Antwerp and Brussels and throughout the north the people are "Flemish" and speak a tongue closely akin to Dutch.

To the south of the factories and the mines of the "Black Country" lie the somber woods and the swift-flowing rivers of the Ardennes hills, which in places are 2,000 feet high. The wild boar still lives in these protected forests, much as it did more than 1,100 years ago when Charlemagne hunted through these woods.

During the Middle Ages the towns of Flanders had built up an industry and commerce which rivaled that of the early 20th century. But in the time that followed, when the land was handed about from one country to another—when the Duke of Burgundy sought to repress the free spirit of the towns; when Philip II of Spain, through his general Alva, drenched the land with blood; and when Austria, after obtaining these provinces by the treaty of Utrecht (1713), tried to crush the liberties of the people—the industries suffered severely. Belgium was annexed to France at the time of the French Revolution, but handed over to Holland as part of the kingdom of the Netherlands in 1815. Not until 1830 did the kingdom of Belgium as we know it come into existence. Then, with its neutrality guaranteed by that treaty which Germany tore up as a "scrap of paper" in 1914, Belgium entered upon its period of greatest prosperity. Since 1830 three kings have ruled the country—Leopold I, Leopold II, and Albert I, the present king. The government is a constitutional monarchy.

The chief questions that have disturbed the country have been the rule over Congo territory (which King Leopold II long held as a private possession), suffrage, and socialism. The first was settled in 1908 by turning over the Congo state to Belgium as a colony. The second was not satisfactorily arranged at the beginning of the World War, for the Socialists, who were constantly gaining in strength, wished for complete manhood suffrage.

While the Germans ruled in Belgium (1914–18), they followed a policy which seemed deliberately intended to crush Belgian trade competition. Of the 50 steel furnaces, 35 to 40 were destroyed; many of the textile mills were put out of commission; machines by the thousands, railroad locomotives and cars, and all available raw materials were carried off to Germany, together with tens of thousands of horses

and cattle; Belgian men and women, moreover, were forcibly deported and obliged to work for their enemies. The historic university city of Louvain was one of many towns and villages deliberately burned by the German army as punishment for alleged acts of hostility by the inhabitants. The people remaining in Belgium were kept alive largely by the efforts of Herbert Hoover as head of the Commission for Relief in Belgium, and by loans from the American government totaling \$180,000,000. Since the close of the war the recovery of Belgium has been rapid. Area (including two

small districts annexed from Germany) 11,760 square miles; population, about 7,600,000.

BELGRADE (*běł-grād'*), SERBIA. Before the Austrian cannon had laid Belgrade, the Serbian capital, in ruins during the early months of the World War of 1914–18, its inhabitants spoke of it affectionately as "the little Paris." And they had reason, for despite the fact that it had only about 90,000 people, it was one of the gayest capitals of Europe, recalling the greater Paris in its wide and crowded boulevards, its innumerable cafés, its lively theaters and music halls, and its beautiful parks and gardens. During the last generation it had lost much of the Oriental air which centuries of Turkish rule had given the old city, and had taken on the appearance of a Western metropolis, with electric lighting and fussy little street cars darting up and down the hilly streets.

Belgrade has a dominating situation on a ridge at the junction of the Danube and Save rivers. On a chalk cliff at the apex, overlooking the broad blue lake formed by the meeting of the rivers, stood the once white walls and towers of the ancient citadel, formerly an important fortress. It is from this citadel that Belgrade got its name, which means "White Castle."

Though the people of Belgrade have adopted the sober dress of Paris and London, the streets of the city are gay with the picturesque and brilliant peasant costumes, for Belgrade is the trading center as well as

THE TRADE CENTER OF BELGIUM



This is the Brussels Bourse, the market for the buying and selling of securities corresponding to the New York Stock Exchange. It was here that the agents of the famous King Leopold, the best financier who ever sat on a throne, conducted many of the negotiations by which the King sold the Congo Free State to his people—the greatest real estate deal in history.

the capital of Serbia. No industries of importance have been developed, however, because of the scarcity of capital and labor.

Few cities have seen more battles, plots, and crimes than Belgrade. As early as the 3rd century B.C. it was a fortified post. The Turks called it the "home of wars for the faith," because before its walls they fought for a passageway for their rule and the Mohammedan religion into central Europe. As the key to Hungary and the gateway to Serbia, it was coveted by both Christians and Turks, and changed

masters again and again. Although Serbia was freed from direct Turkish rule in 1829, the Turkish garrison was not withdrawn from Belgrade until 1867. During the World War it was reduced to ruins by the Austrians and twice captured by them, the last time on Dec. 13, 1914. It was not regained by the Serbians until Nov. 3, 1918.

BELL. When the armistice that ended the World-War of 1914-1918 was signed, thousands of church bells throughout the United States and the other victorious nations pealed out the glad tidings. Some of the English bells that were set swinging on that day are so ancient that they may have been used to celebrate every notable event in English history, from the signing of the Magna Carta in 1215, and have tolled for every ruler of England since the death of John Lackland.

Voices of History in the Bells

From the early centuries of the Christian era the ringing of great bells has been used to mark the divisions of the day, to summon the faithful to prayer, and to announce tidings of joy or sorrow. They have sounded the alarm of fire and the tocsin of war, and have given the signal for many a deed of terror and blood. At Eastertide in 1282 the vesper bells of Messina marked the beginning of one of the most atrocious massacres in history, which

has ever since been known as the "Sicilian vespers." And on Saint Bartholomew's Day in 1547, church bells gave the signal for the massacre of thousands of Huguenots in France.

In the days of ancient Greece and Rome bells of this sort were unknown. The only bells the ancients had were small handbells, often shaped like the square-mouthed bells we tie to the necks of sheep and cattle, or they were closed bells like our sleigh-bells. Such small bells were hung about the necks of dogs and cattle, and small tinkling bells of gold were attached to the dress of high-priests of the Hebrews.

The First Church Bells

By the 5th or 6th centuries of our era, when Christianity had firmly established itself in the Roman Empire, bells were in use in Christian churches. At first they were of small size, but gradually they became larger, and were placed in high towers so that they could be heard throughout the city. Sometimes these towers were built as a part of the church; but often they were separate structures, especially in Italy, where the bell-towers or *campaniles* (from the Latin word *campana* meaning "bell"), developed into structures of extraordinary beauty. Among the most famous and beautiful of existing bell-towers are the campanile of Saint Mark's at Venice, which collapsed in 1902 after standing a thousand years, and was rebuilt in 1912; the leaning tower of Pisa; and Giotto's campanile at Florence. The beautiful tower form developed by the builders of the Middle Ages has been copied by modern architects for the towers of some of our great sky-scrapers.

The earliest bells preserved in the British Isles, like the famous Saint Patrick's bell at Belfast, which is supposed to date from the 6th century, were of the ancient rectangular shape, and they were made of thin plates of metal riveted



No skilled performer on the piano or any other musical instrument ever took more pride in his work than did the old bell-ringers of England, such as Dickens has immortalized in his story of 'The Chimes'. You see how this old gentleman operates three bells by using his foot as well as his hands. Bell-ringing is still an accomplishment in rural England.

together. Gradually men learned the art of casting bells in one piece, and worked out the familiar curving bell-shape which produces the most brilliant tone and the longest vibrations.

THE BELLS OF ST. CLEMENT'S



Here is a view inside the tower of the famous bells of St. Clement's in London. Eight of the bells are attached to those wheels you see in the upper room, while the ninth, the Sanctus bell, is lodged in the steeple.

The process of casting bells is much the same today as it was many centuries ago. A core of bricks is built up and covered with soft clay, molded to the outline of the inside of the bell. Then an outer mold or "cope" of clay is made, shaped to the outline of the outer surface of the bell, and the molten metal is poured in and left to harden. When the molds are removed the bell may be tuned to the desired tone by taking off thin shavings from the inside.

Metals Used for Bells

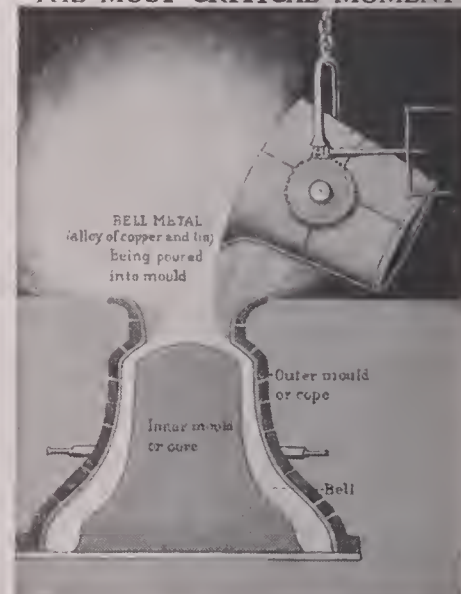
From the earliest times—as far back as the days of Nineveh—the metal most used was an alloy of copper and tin in various proportions (*see Alloys*). Iron and steel were occasionally used, but bells so made are much inferior in tone.

It has long been customary to hang several bells of different pitch together, which are made to sound one after the other and thus play simple tunes; these are called a "peal" of bells, or "chimes." Each bell was rung by pulling a separate rope. As the number of bells increased from 3 to 8, or even 12, an elaborate art of bell-ringing was developed. With three bells, only six "changes," or sequences, are possible, while eight bells give the enormous number of 40,320 changes. With 12 bells the number is so great that it has been calculated that to ring the changes at the rate of two strokes to the second would require 91 years. Bell-ringing became a fascinating popular amusement in England in the 17th century. Societies were formed all over the kingdom which performed wonderful feats of accuracy and endurance in competition. The patterns or tunes were worked out by experts and received many queer names, such as "Kent treble bob major," "Grand-sire Triples," "Treble bob royal." The art of bell-ringing is still practiced with enthusiasm in rural England.

In the United States and the Continental countries, especially Belgium, chiming is usually done by mechanical devices. Sometimes as many as 60 or 70 bells are thus played by means of a keyboard or levers, so that any tune may be played with its accompanying harmonies. In "ringing," properly so called, the bells are swung through a complete revolution, resting bottom-upward at the end of each swing. "Chiming" is the technical term for swinging the bells in their normal position just far enough to be struck by the clapper, or for producing tones by striking the stationary bells with small hammers. The latter method is used in all mechanically operated chimes or *carillons*. These *carillons* are sometimes played by means of a cylinder, just like a barrel-organ, which is set off at regular intervals by clockwork or by turning a crank by hand.

In this country bells are customarily used only for striking the hours, for fire-alarms, for special celebrations, and for announcing religious services. In the older nations many of the ancient uses still survive. The bell in the parish church sounds the rising signal at five or six o'clock, indicates the time for dinner, and sounds the curfew or retiring signal at eight or nine.

THE MOST CRITICAL MOMENT



Casting a bell is a very difficult art, for the slightest flaw, such as an air bubble or a tiny crack that comes as the metal cools, may ruin its musical note.

THE LARGEST BELL IN THE WORLD

The curfew (from the French *couvre-feu*, "cover fire") has rung in many parts of England every night since the time of William the Conqueror. In many places in the United States it has been introduced as a signal—say at nine o'clock—when children unaccompanied by adults must leave the streets and go home. At Oxford University, 101 strokes are rung on "Great Tom" in Christ Church College at nine o'clock every evening to warn the undergraduates to return to their colleges.

Smaller bells of various shapes are used for an infinite variety of purposes—attached to clocks to sound the hours or to waken us in the morning, to summon us to the telephone or announce the presence of a visitor at the door, to call us to meals, and to summon servants. Instruments of various bell-types are also important members of the modern orchestra (see Musical Instruments).

The Giants among Bells

The largest bell ever cast is the "Czar Kolokol" at Moscow, which weighed about 220 tons when it was cast in 1733. It has never been rung, however, as it was cracked in the casting. This great bell is more than 22 feet in diameter and stands 19 feet 3 inches high; it now rests on a raised platform and is used as a chapel. Another Moscow bell, the largest in actual use, weighs 110 tons. There is a great bell of about 87 tons in a pagoda in Upper Burma, and one of 53 tons at Peking. Besides these monarchs the other famous bells of the world are dwarfs. "Great Paul" in Saint Paul's Cathedral, London, weighs 17 tons; "Big Ben" in the Westminster clock



The Czar bell in Moscow is the largest bell in the world. It is 19 feet high, 60 feet in circumference, and weighs 220 tons. The outside is adorned with inscriptions and reliefs. The bell was cast in 1733, but before it left the foundry a fire broke out, and cracked it as you see here, so that its giant voice was never heard.

tower of the Houses of Parliament, London, 13½ tons; "Great Tom" at Oxford, 6 tons. The largest bell in the New World is in the Cathedral of Notre Dame, Montreal, and weighs 14½ tons. The most famous bell of the United States is the Liberty Bell, which rang out the news of the Declaration of Independence in 1776.

BELL, ALEXANDER GRAHAM (born 1847). Other men before Bell had worked at the problem of transmitting to a distance the sound of the human voice, and many other men since have helped to improve and perfect Bell's invention. But Alexander Graham Bell will always be remembered as the real father of the first

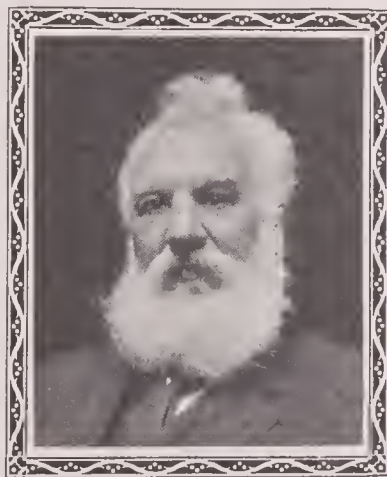
practicable electric telephone.

He was born in Edinburgh, Scotland, and was educated in the Universities of Edinburgh and London. In 1870 he removed to Canada with his father and the rest of the family. His father and his grandfather before him had devoted their lives to the study of human speech and to teaching the deaf and dumb to speak, and this became the profession also of Alexander Graham Bell.

During 1874-75 he worked at the problem of the telephone. It was on March 11, 1876, that the first spoken message successfully transmitted by wire was sent by him to his assistant in a Boston hotel. He filed his application for a patent for his invention on March 14 of that year, just two hours before Elisha Gray filed a notice

in the Patent Office covering some of the same principles. At the Centennial Exposition of 1876, in Philadelphia, the demonstrations of Bell's telephone

ALEXANDER GRAHAM BELL



Inventor of the Telephone

HERE SLEEP THE BRAVE NEAR BELLEAU WOOD



This spot in the Marne valley in France is sacred to the memory of American soldiers. Those rows of white tombstones mark the graves of the heroes of the Marine Corps who died in the battle of Belleau Wood. This photograph was taken not long after that fierce encounter, in which the Marines drove through the German lines under a hail of shot and shell. The torn trees in the foreground show the effects of the withering artillery fire.

made a great sensation. That same year he erected the first real telephone line, in Brantford, Canada, where his father resided. Soon telephone systems were to be found in every city, and today Bell's invention is a necessary part of the equipment of every factory and office, and of most up-to-date homes.

In his later years Mr. Bell has resided in Washington, D. C. He rendered many public services, and made many other inventions; and he was honored by universities and learned societies throughout the world. His fame, however, will always rest on the invention of the telephone—by means of which we now speak across seas and continents, with or without wires, and can even communicate with the aviator in the clouds.

BELLEAU (*bě-lō'*) **WOOD, FRANCE.** Five and a half miles northwest of Château-Thierry stands Belleau Wood—now officially named "Bois de la Brigade Marine"—the scene of one of the first and most glorious exploits of the American troops in the World War of 1914-18. There, early in June 1918, the marines of the 2nd Division, assisted by the regulars of the 3rd Division, advanced into a rocky jungle of machine-gun nests, and alternately held fast or charged with their battle-cry of "*E-e-e-e y-a-a-h-h yip!*" until they had driven out the Germans and captured the village of Bouresches, two miles to the south. Of this exploit the report of the Secretary of the Navy says:

"In all the history of the Marine Corps there is no such battle as that one in Belleau Wood. Fighting day and night without relief, without sleep, often without water, and for days without hot rations, the Marines met and defeated the best divisions that Germany could throw into the line. The heroism and doggedness of that battle are unparalleled. Time after time officers seeing their lines cut to pieces, seeing their men so dog tired that they even fell asleep under shell fire, hearing their wounded calling for the water that they were unable to supply, seeing men fight on after they had been wounded and until they dropped unconscious; time after time officers seeing these things, believing that the very limit of human endurance had been reached, would send back messages to their post command that their men were exhausted. But in answer to this would come the word that the lines must hold, and if possible those lines must attack. And the lines obeyed. Without water, without food, without rest they went forward—and forward every time to victory. Companies had been so torn and lacerated by losses that they were hardly platoons; but they held their lines and advanced them. In more than one case companies lost every officer, leaving a sergeant and sometimes a corporal to command, and the advance continued."

BENAR'ES, INDIA. With its 1,500 temples and more idols than inhabitants, the ancient city of Benares is the Mecca of all Hindus. Its very air is holy, its



THE HOLY CITY OF THE HINDUS



At Benares the sacred Ganges, whose waters you see on the right, makes a magnificent sweep some four miles in length. On the outside of this curve and on a rising bank stands this group of great temples. During certain seasons of the year the river here is filled with pilgrims from all parts of India, purifying themselves in the holy waters. In the foreground of this picture are the "burning ghats" where you see a little group of people about a pyre ready for the cremation of a body.

soil so sanctified that to carry away its dust on your feet is a sin. Pilgrims in countless numbers visit it to wash their sins away in the sacred Ganges, and many of the wealthy spend their declining days here, for he who dies at Benares is sure of immediate admission into heaven.

From the river you see Benares as a richly colored jumble of temples, mosques, palaces, domes, and minarets flung haphazard along the steep bank. At the water's edge run the famous *ghats* (steps), a four-mile curving row of stone terraces.

You cannot see the city from a *gharri* (carriage); its canyon-like streets, rising in narrowing flights of steps, are barely wide enough for a single horseman. You must go on foot through the cold slippery passageways, threading your course amid bewildered pilgrims making the rounds of the sacred road (called *Panch-kos*) and thus being cleansed from all sin. Now and then you will have to give way to a sacred bull which wanders unrebuked from one grain-seller's stall to another, nibbling where he will. You pass the Golden Temple, holiest of all, its floor paved with silver rupees, and go into a crowded sanctuary, where burning camphor-laden leaves are dropped by worshipers, crowding round the mouth of a pit, to illumine far below a flower-enshrined image of the god Siva.

Often you stop to watch a weary sinner, who has stepped aside a moment from the surging throng to make *pūja* (worship) before a shrine, at which he leaves two *pice* (copper coins) and a load of sins. Beggars swarm everywhere.

Go down to the ghats—what a sight greets the sun each morning as it rises out of the richest plain in all India! Gray granite and red temple walls, the golden shafts of slender spires, the stately minarets of a hidden mosque, a *mullah* (Mohammedan priest) counting his beads while he drones a passage from the Koran, monkeys gamboling over temple walls, lazy *fakirs* (holy men) clothed in nakedness and ashes, fat Brahman priests thumbing sacred texts beneath flame-colored umbrellas. The sweeper's wife, knee-deep in "Mother Gunga," as the Ganges is piously called, dabbles at a red *sari* or copper pot, her prayers finished; three feet away a high-caste banker, filling his cupped hands with Ganges water, sends his praises to the sun, "who illumines the whole world, the lord of all creatures—may he enlighten my soul!"

Naked children dart in and out of the water near a great pyre or funeral fire, where circling wreaths of smoke rise around a smoldering corpse, while the soul, freed by the cleansing flames, slips out into the next stage of endless reincarnation. Troops of women,

their abolutions over, patter off up the steps, straight of limb, aristocratic in every line, like slim goddesses. The tinkle of their silver anklets mingles with the ceaseless chatter of monkeys, the rattle of metal and resounding clang in the brassware bazaars, sharp piercing conch blasts, the muffled murmur of swarming worshipers, the deep booming of the temple drums.

Benares was a center of importance when Buddha came there, six centuries before Christ, but its buildings are all comparatively modern. The houses are generally shops on the ground floor; their upper stories, often as many as five or six, are made more livable by projecting balconies and verandas and their walls are garish with bright colors. Population, about 200,000.

BENEDICT XV, POPE (born 1854). Giacomo della Chiesa, the present Pope, comes of an ancient and noble family of Genoa, which counts in its history two saints, a cardinal, and several bishops. Perhaps it was this tradition that early turned inclinations of the young Giacomo to the church. In obedience to his father's wishes he completed a course in law at the University of Genoa, winning a high place in his class. But the day that he took his degree, he said:

"Father, I have obeyed you about my studies and now wish my reward. I must enter the church."

He was ordained to the priesthood at 24, and became secretary to Cardinal Rampolla, papal nuncio at Madrid and later the papal secretary of state at Rome. In this capacity he gained an acquaintance with international politics and diplomatic procedure which proved invaluable when he himself was elevated to the highest office in the church.

In 1907 the future Pope was created archbishop of Bologna. In May 1914, he was made a cardinal; and in September of the same year, following the death of Pope Pius X, he was elected Pope in a conclave which lasted only four days—the shortest in the history of the Papacy.

The new Pope found himself facing such problems as had confronted none of his predecessors. Half the world was in arms, waging the fiercest struggle of all time; and adherents of the Catholic faith were found on both sides. The policy he set for himself was the observance of strictest neutrality, accompanied by unrelenting endeavor to effect peace at the earliest possible moment.

The Pope outspokenly condemned Germany's violations of the laws of war, such as the destruction of the cathedral of Reims, and obtained some improvement in the treatment of prisoners of war by the Central Powers. In August 1917 he invited the belligerents to make peace upon a basis of the restitution of all occupied territory, renunciation of indemnities, decrease in armaments, freedom of the seas, and international arbitration. The Central Powers returned an evasive reply. President Wilson, as spokesman for the Allied Powers, answered by pointing out in substance that such a program would be fruitless so long as the people of Germany were dominated by an irresponsible and militaristic government, whose word could not be trusted.

Pope Benedict is an accomplished and ardent scholar, remaining true amid the distractions of his busy career to the ideal of his youth. So intense was his devotion to his studies as a lad that his mother, to induce him to take needed exercise, gave him a spade and bade him spend a few minutes every day digging in the garden. A palm planted by the future Pope is now one of the most prized possessions of his boyhood home. As Pope, he still clings to the studious and simple habits of his youth, being always found at his altar by half past five or six, and at his desk ready for the day's work by eight o'clock.

Of the earlier popes who have borne the name Benedict, the first (574-78) died of grief during the Lombard devastation of Italy. Benedict V (964-65) was carried to Germany by the Emperor Otto I and died a prisoner there. The name Benedict XIII was taken by the Spaniard Peter de Luna, one of the anti-popes (1394-1409) at Avignon during the Great Schism; it was also borne by the canonical pope at Rome (1724-30). Benedict XIV (1740-58) was renowned for his great learning and piety, and for his measures to promote the well-being of the city of Rome.

BENEDICTINES. An order of monks established by St. Benedict in Italy about 530 A.D. Because of the color of their robes they are sometimes called "Black monks." There is also an order of nuns of the same name. (See Monks and Monasticism.)

BENGAL'. A province in the northeastern part of British India, with an area (78,700 square miles) about equal to that of Kansas, and a population (about 45,000,000) more than two-fifths that of the United States; before its partition in 1912, its area was almost twice as large. It includes the fertile deltas of the Ganges and Brahmaputra rivers. The best cotton of India is grown in Bengal, and it is a chief center of the manufacture of cotton goods. The staple crop is rice, and other important products are dates, sugar, wild silk, jute, tea, and opium. The province is also rich in coal and iron. Calcutta is the capital and largest city.

Bengal was the first district in India in which the British passed from mere trading rights to the exercise of the right of government. Here was fought (in 1757) the battle of Plassey which established British in place of French supremacy. The people are predominantly Hindus, intelligent, politically active, but non-warlike. (See Calcutta; India.)

BENTON, THOMAS HART (1782-1858). The first and one of the greatest of statesmen to arise in the vast region west of the Mississippi River was Thomas Hart Benton, for 30 years United States senator from Missouri. Although Benton typified the West and identified himself largely with its interests, he is forgotten by many today, while his great contemporaries, Clay, Webster, and Calhoun, the champions of North and South, are remembered by all.

Born in the interior of North Carolina, Benton followed the frontier to Tennessee, where he was admitted to the bar and began his political career as a member of the state senate. Although he was a member of Gen. Andrew Jackson's staff during a part of the War of 1812, the two became involved in a duel,

HIS HOLINESS, POPE BENEDICT XV



Cardinal Giacomo della Chiesa was leading the life of a quiet scholar in Rome when Pope Pius X died in 1914. He was known only to a few churchmen outside of Italy. Then he was elected to the chair of St. Peter, after the shortest conclave in the history of the Papacy, and within two hours his name had flashed to every corner of the earth. The quiet scholar had become the spiritual head of 275,000,000 Roman Catholics throughout the world.

contained in the Easy Reference Fact-Index at the end of this work

in which Jackson was wounded, and this broke the friendship between them for many years. After Benton entered the United States Senate, in 1821, his political views coincided so closely with those of "Old Hickory" that it was impossible for the two to stay apart; and during the period of Jackson's supremacy, 1829-1841, Benton supported all of the President's policies (see Jackson, Andrew).

Benton was always an advocate of the interests of the West, urging a liberal land policy and the construction of transcontinental railways, saying: "*There is the East; there is the road to India.*" But when the slavery question became dominant, he sacrificed his political career to uphold the cause of the Union. After 30 years in the Senate he was defeated for reelection in 1850 because of his opposition to the Compromise of that year. He was subsequently elected for one brief term to the national House of Representatives; but the southern sentiment was too strong in Missouri, and in 1854 his political career came finally to an end. He devoted the remainder of his life to writing his 'Thirty Years of Congress,' and arranging for publication the debates of Congress down to 1850.

Although Benton died before the Civil War began, his influence played a part in keeping Missouri in the Union in the critical days of 1861. His words to Calhoun were frequently recalled: "I shall be found in the right place—on the side of my country and the Union!"

BEN'ZOL. One of the first products of the distillation of coal-tar is the colorless liquid known as benzol. It forms a great many compounds with other substances and hence is very important in commercial chemistry. Many drugs and dyes, including aniline dyes, may be made from it as a starting point. One great branch of organic chemistry is concerned with the "aromatic hydrocarbons," which are derivatives of benzol.

Benzol is lighter than water and does not mix with it or dissolve in it. It is poisonous and often produces illness and sometimes death among the workmen who breathe its vapor. It is very inflammable and burns with a luminous and smoky flame. The mixture of the vapor with the air makes an explosive gas. A pupil of the great chemist A. W. Hofmann, who first found benzol in coal-tar in 1845, lost his life in a benzol fire.

The chemical formula for benzol is C_6H_6 . It is also known as "benzene," which must be distinguished from "benzine." Benzine, too, is one of the products of distilling petroleum; it is like naphtha and gasoline, and is much used in the household for cleansing, since it readily dissolves fats and oils. Like other petroleum products it is highly inflammable, and serious accidents are common as the result of using it near lighted lamps or cigars. (See Coal-Tar Products.)

BEOWULF (*bā'o-wulf*). The ancestors of the English, like all primitive peoples, delighted in listening to their minstrels or poets, who sang of war and deeds of valor, of great heroes and chieftains. When these peoples left their homes on the continent and came to the British Isles, they brought with them songs relat-

ing to the deeds of the hero Beowulf, and these were later woven together into the great Anglo-Saxon epic or heroic poem which bears his name.

The poem tells how the "battle-brave" Beowulf came over the sea from Geatland (possibly the Sweden of today) to the land of the Danes and freed that country from the terrible ogre Grendel; how he was forced to battle with Grendel's mother, who came to avenge her son's death; and how, long afterwards, when Beowulf had been king of the Geatas for half a century, he came to his death in killing a fire-breathing dragon which had ravaged the land. Amid the mourning of his subjects the good king was buried under a great barrow or mound, while the warriors rode around it singing that he was—

. . . of kings, of men,
The mildest and the kindest, and to all
His people gentlest, yearning for their praise.

Beowulf is the earliest English epic poem, and the language has undergone such changes since the time when it was written that only those who have studied the old Anglo-Saxon language can read the story in the original. It has been translated into modern English, however, and in this form may be read by any boy or girl who likes a story of heroism and adventure. Rude as the poem is, it is great because of its strength and vigor, its simple vivid pictures, and most of all because it is an expression of the manly and noble ideals which still hold sway over the English-speaking peoples.

Scholars do not agree as to how old the epic is or when it was first put into writing, but the oldest form in which it has come down to us is in a manuscript written in the 10th century, and now preserved in the British Museum, London.

BERING SEA. Both the sea and strait of this name were first discovered by a Russian Cossack, Deshnef, in 1648; but they were named in honor of Vitus Bering (or Behring), a Danish navigator in the employ of the Russian czar Peter the Great, who made the first systematic explorations during the years 1725 to 1741. Bering died in 1741 on an island near Kamchatka, which now bears his name.

Bering Sea is part of the North Pacific Ocean, and is bordered by Alaska, the Aleutian Islands, Kamchatka, and Siberia. It extends about 1,500 miles from east to west and about 1,000 miles from north to south; on the north it leads to the Arctic Ocean through Bering Strait. It is a sea of almost perpetual fogs, and for a large part of the year it is obstructed with ice in packs and floes. Navigation, however, is usually possible from June to November. Bering Sea receives several large rivers, including the Yukon from Alaska and the Anadir from Siberia. It is comparatively shallow, being not more than 600 feet in the northern part. Bering Strait, lying between the projecting peninsulas of Siberia and Alaska, is about 50 miles wide and has an average depth of 200 feet.

In 1881 the United States sought to declare Bering Sea a *mare clausum* or "closed sea," open to naviga-

IN THE CAPITAL OF THE FORMER GERMAN EMPIRE



General View of Berlin

The high dome to the right marks the great Lutheran Cathedral. The long building with the lower dome to the left is the former royal palace where Kaiser Wilhelm II and his family lived. Between the Cathedral and the Palace, stretching away to the horizon, is the famous "Unter den Linden," one of the handsomest streets in the world.



National Gallery

The National Gallery of Modern Painting and Sculpture is built in the style of a Greek temple, surrounded by colonnades. In the foreground is the Friedrich bridge over the Spree River which runs through the heart of the city. The photograph at the left shows the Reichstag building, with its huge glass dome, where the German parliament sits.



Parliament (Reichstag) Building



Brandenburg Gate

The Brandenburg Gate is at the end of Unter den Linden. It was designed in imitation of the Propylaea at Athens. Over it is an image of Victory in a chariot drawn by four horses. The entire group is cast in copper. The Brandenburg Gate leads into the Tiergarten, one of the largest zoological parks in existence. To the right we see a section of the Berlin elevated railway. It is built on a series of masonry arches, beneath which shops and storehouses are frequently situated.



Royal Theater (Center)



Berlin Elevated Railway

Berlin's early love for Greek architecture appears again in the Royal Theatre, built in 1821. This great marble structure is maintained by the government, as is also the Berlin opera house. The high-domed structure to the right is one of Berlin's many churches. Indeed, this theatre is flanked on each side by a church, the corner of the second one being just visible at the left. In the center of the theater square rises a beautiful national monument to the great poet Schiller, 19 feet high.

tion and sealing only under conditions imposed by this country; but an international court of arbitration, held in 1893 to consider the sealing question, refused to recognize this claim.

BERLIN, GERMANY. During the World War of 1914-18 many an American "doughboy" announced proudly when he left home that he was "on his way to Berlin," and most of them were anxious to march through the streets of that German capital with their victorious allies before they returned to civil life. This wish was destined to be ungratified, for Berlin

lies far beyond the zone of "occupied" German territory given over to the armies of the Allies by the armistice of Nov. 11, 1918.

Situated on the Spree River in the former kingdom of Prussia, almost equidistant from the northern and southern and from the eastern and western boundaries of Germany, Berlin is admirably located for the political center of the country. Its accessibility is increased by the great network of railways which converge upon it. This rail communication with all parts of Europe aided in making Berlin before the World

War one of the greatest industrial and commercial cities on the continent, while in wealth and population it ranked third in Europe, immediately after London and Paris. In it were great factories for the making of woolen cloth, dyes, furniture, railway supplies, machinery, and steam engines, which employed more than one-half the working population.

In spite of its age—for it was probably founded in the 13th century—Berlin is a very modern city. In 1871, when the German Empire was formed, Berlin had a population of 826,000 inhabitants; at the time of the World War, in 1914, it had grown to a city of nearly 4,000,000 inhabitants, including suburbs—one of the most amazing growths in history. The appearance of the city, too, is modern, with its imposing buildings and wide avenues. Its most famous street is "Unter den Linden"—so called from its long rows of lime or linden trees, which lead from the former imperial palace, with its 600 rooms, to the Brandenburg Gate, the only one remaining of the numerous gates of the old Prussian city. Surmounting this gate is the famous bronze Car of Victory, which was carried to Paris by Napoleon in 1807, but was returned to its former position when that disturber of the peace was banished to St. Helena. Unter den Linden was the political and social center of the empire. Along it are situated the University of Berlin, the palace of the imperial chancellor, the palaces of the emperors William I and Frederick III, the French and Russian embassies, and the royal library. The university, although not founded until 1810, is the center of the learning of Germany, and has on its teaching staff the foremost men of German letters and science. Elsewhere are the Reichstag building, the Royal Theater, and a number of other theaters and opera houses, and numerous museums and palaces.

With Prussian thoroughness the rulers of Berlin saw to it that the people should hold in grateful remembrance those who have contributed to the growth of the city and the Prussian state. Her streets and parks, therefore, are dotted with pretentious statues erected to the memory of rulers and generals. Among these of course the Hohenzollern rulers, who since the 15th century made Berlin the seat of government for the mark of Brandenburg, held first place. When Brandenburg grew into Prussia, Berlin remained the capital; and when Prussia expanded into the German Empire in 1871, that city became the imperial capital. Although the statues of war leaders predominate, those erected to Rauch, Hegel, Schiller, and Jahn show that the leaders in peaceful pursuits have not been entirely forgotten.

Like other German cities, Berlin was impoverished during the World War by the blockade which cut off its trade, and it suffered severely from the riots which accompanied and followed the revolution of 1919. Although no longer the home of the Hohenzollerns, it remains the chief city and capital of the German Republic, as it was of the empire. Population of Berlin proper, excluding suburbs, about 1,900,000.

BERMUDAS. Two days' steaming southeast from New York brings you to the delightful group of coral islands called the Bermudas. Frosts are unknown, the winter temperature ranging between 50 and 70 degrees, so the luxuriant vegetation is green the year around. Every winter brings tens of thousands of tourists from the United States and England.

Only 20 of the islands are inhabited, though there are about 350 islands, islets, and reefs in all, with an area of about 19 square miles. Bermuda Island, which occupies about three-fourths of the total area of the group, is connected by causeways and bridges with some of the smaller islands. Its chief town, Hamilton (population, about 2,600), is the seat of the government, which is in the hands of a governor and a council of six members, appointed by the British government, and an elected assembly.

The Bermudas are strategically valuable to Great Britain as a naval base half-way between Canada and the West Indies, and have risen in importance since the opening of the Panama Canal. St. George's Island has a strongly fortified harbor and there are extensive naval establishments on Ireland Island, with dockyards and a large floating dock. Most of the trade is with the United States and Canada. The absence of frosts permits winter planting, and Bermuda early potatoes, onions, and other garden vegetables bring high prices at New York. A large proportion of the Easter lilies sold in the United States are grown in Bermuda, and the fields where these grow are one of the sights.

The islands get their name from the Spaniard Juan Bermudez, who discovered them in 1515. They are also sometimes called the Somers Islands, from Sir George Somers, who first settled them early in the 17th century. Population, about 22,000, of whom about one-third are whites.

BERN, SWITZERLAND. As the sun sinks into the golden west at Bern, the fortunate visitor beholds to the eastward one of the most splendid sunset spectacles in nature. For there, where rise the snow-capped peaks of the Bernese Alps, 20 to 30 miles away, the magic of the Alpine glow creates wonderful towers and pinnacles and minareted cities of exquisite rose and gold and violet, as glorious as a saint's dreams of Paradise and as evanescent as the colors of the dying dolphin.

This capital city of the Swiss confederation lies in western Switzerland, on a plateau around whose base flows the River Aar, one of the upper tributaries of the Rhine. The city's name comes from the German word *Baern* meaning "bears," and was adopted, according to legend, because of the great number of bears that were killed there the day the city was founded. The bear is the heraldic emblem of Bern, and bears in wood and stone are used everywhere as decorations for the buildings. There is a curious old town clock which heralds the striking of the hours by the crowing of a cock and a procession of tiny bears. The city maintains a bears' den on the right bank of

the Aar, in which there are always a number of fat sleek bears.

The Aar flows completely around the old town, except for a narrow neck to the west. The streets of the city are straight for the most part and dotted with fountains. Among the public buildings are a great cathedral begun in 1421 and not completed until 1894. The Council building (*Rathaus*) is another building dating from the Middle Ages. The Parliament house, in which are held the sessions of Federal Congress of the confederation, commands a splendid view of the Alps. The city is a great industrial center, noted for its manufacture of woolens, linens, cottons, silk stuffs, watches, clocks, toys, scientific instruments, and chocolate.

Bern was founded in 1191, and entered the Swiss Confederacy in 1353. In 1405 the greater part of the city was destroyed by fire, but it was afterwards rebuilt. Bern became the capital of Switzerland in 1848. Population, about 112,000.

BETEL. A preparation of the nuts of the betel palm (*Areca catechu*) has been the "chewing-gum" of the people of the Orient for at least 2,500 years. Nearly one-tenth of the human family practice betel chewing and in the East Indies, where this drug habit is most general, nearly every native man and woman, young and old, carries a betel box.

The kernel of the nuts, which are about the size of a small hen's egg, is prepared by boiling, drying, and slicing. A small piece is placed on the leathery leaf of a vine belonging to the pepper family (called "betel

vine"), together with a bit of quicklime, and the whole is rolled into a pellet. When chewed the pellets have a sharp, stinging, peppery taste, color the saliva brick red, stain the gums and lips, and blacken the teeth. Many betel chewers are toothless at the age of twenty-five. In India the betel chew is usually called *pawn*.

BETHLEHEM. At the foot of a hill in Palestine thickly covered with vines and olive trees, slumbers the peaceful little town of Bethlehem, which shares with its near neighbor Jerusalem the distinction of being the most sacred spot in Christendom. At the end of its long straggling street, lined with low, flat-roofed houses, is the shrine to which millions of pilgrims have turned their steps—the magnificent Church of the Nativity erected, in 327, over the grotto where Christ is believed to have been born. The nave of this beautiful and interesting church which monarchs have vied in adorning is said to be the oldest monument of Christian architecture in the world. In the grotto below, a marble trough marks the traditional spot where the manger-cradle stood. A famous altar, called the Altar of the Innocents, marks the reputed burial place of the 2,000 children who, according to the New Testament account, were slain by Herod.

But even before the birth of Christ, Bethlehem was a place of great fame, for it was the scene of the romance of Ruth and of the death of Rachel. It was also the birthplace of David, and in it he was anointed king by Saul. Population, about 8,000.

The BIBLE, the WORLD'S BOOK of BOOKS

*How the Marvelous Jewish and Christian Scriptures Have Come to Us
Across the Centuries and, Though Written in Ancient Tongues,
Still Speak to All the Language of the Soul*

BIBLE. In a narrow cell in a monastery of England, nearly 1,200 years ago, lay the Venerable Bede, the most famous scholar of his day in Western Europe. Feebly he dictated his translation of St. John's Gospel, for although desperately ill he would not rest from his labors.

"Go on quickly," he commanded the scribe. "I know not how long I shall hold out or how soon my Master will call me hence." All day long they worked, and when the rays of the setting sun glided into the quiet room, the task was almost done.



The Venerable Bede Dictating the Last Words of St. John's Gospel to the Young Scribe.

"There remains but one chapter, master," said the anxious scribe. "Will you not rest now?"

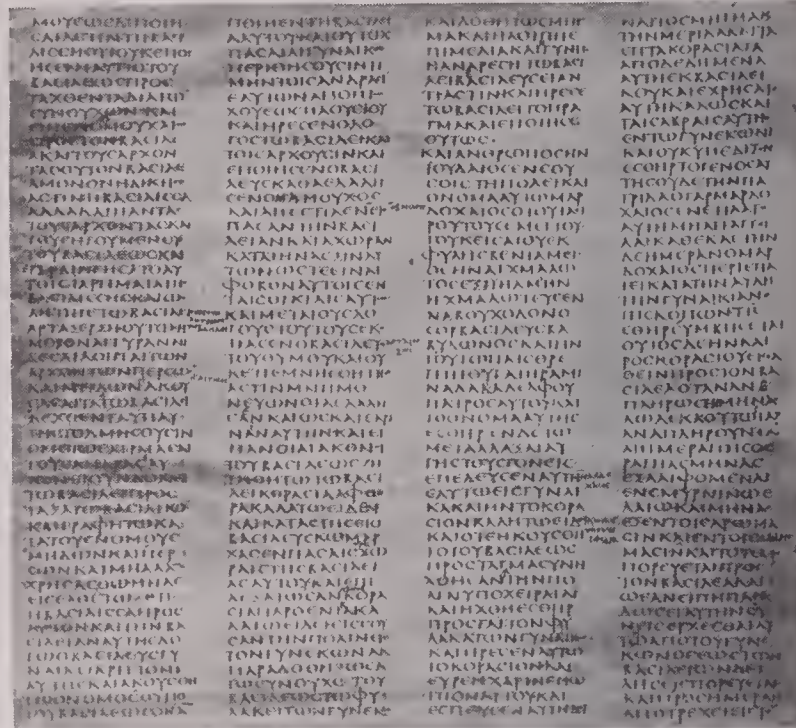
"Nay, we must go on," Bede replied. "Take up thy pen again and I will translate."

His eyes blinded with tears, the young scribe wrote on. "And now, father," said he, as he set down the last sentence from the quivering lips, "it is

finished."

"Ay, it is finished," echoed the dying Bede. And turning his face to the window where he had so long worked and prayed, he died.

ANCIENT MANUSCRIPTS OF THE BOOK OF BOOKS



On the left is a piece of papyrus containing part of the Twelfth Psalm in Greek translation, one of the earliest existing manuscripts of any portion of the Bible. On the right is a leaf from a Greek parchment of the Bible, of the 3d century; it was discovered in a monastery on Mt. Sinai in 1843. Most of this particular manuscript is now in a library in Petrograd.

This saintly scholar is only one of the many great men who have given their lives that the world might have the Bible, the sacred book of Christianity. This great book has woven itself into the very life of the Christian peoples. Translated into Latin, its lessons were the basis of all the church services of the Middle Ages. That its message might be available for the heathen Teutons and Slavs, Ulfilas devised the Gothic alphabet and Cyril the Russian. An English translation of the Bible was the chief treasure of that little band of Puritans who set sail for America to find "freedom to worship God" in their own way. It has been on every battlefield since the printing press made it available to all. Explorers have carried it into the frozen North and into the heart of the tropical jungles for consolation on their hard journeys; and missionaries, many times at the cost of their lives, have brought its message to heathen lands.

The Book that is Really a Library

But the Bible is more than our great sacred book; it is also our greatest literary heritage. There is no other book worded with more haunting beauty than our English Bible. Merely as literature, it has made a deeper impression upon the human mind than has any other book, and the extent to which it has helped shape the world's ideas cannot be estimated. No matter how much you may know of poetry and prose, you cannot consider yourself well read unless you are thoroughly acquainted with the Bible. It is a library rather than a book, for it is a collection of 66 books, each distinct in itself, abounding in literature of the highest type. Almost every phase of life and thought is dealt with, and every form of literature is included in its pages—stories, biographies, letters, orations, prayers, hymns of praise and thanksgiving, fierce war songs, tender love lyrics, fables, proverbs, epigrams,

genealogies, and chronologies. The vigor and dramatic force, the beauty and grandeur, of some of these books have not been excelled in any other writing.

The Bible has two great divisions, the Old and the New Testament. Testament means "covenant" or mutual understanding—a covenant between God and His people.

The Old Testament and the New

The Old Testament is the record of the history and religious literature of a little band of people, the Jews, who believed in one God who was loving and just. All about the little country of Palestine were great and powerful nations, who worshiped many gods, but Israel held fast to its monotheistic belief. In the New Testament is the story of the life of Jesus and his teachings, and the acts and epistles of the Apostles. All through the Old Testament are promises that God would give His people a deliverer; and these promises, which Christianity teaches were fulfilled in the life and death of Jesus, give the thread of unity binding the Old Testament to the New.

One of the most wonderful things about this wonderful book is the way it has been preserved through the ages, and the way its narratives are supplemented by the records of the mighty empires which surrounded the little country of Palestine—Babylonia, Assyria, the Persians, the Hittites, and the Egyptians.

The Old Testament was written in Hebrew (except for a few passages in the related Aramaic dialect), and the New Testament in a popular form of Greek and in Aramaic. Into every country where Christianity spread, the Bible was translated into the language of that country—first into various Eastern dialects, then into Latin, the language of the Romans, and then into the languages of Western Europe. No

other book has been translated into so many languages. The whole of it has been translated into 108 languages, and parts of it into more than 500. The greatest of the early translations was that into Latin made by St. Jerome, who lived about 400 years after Christ. This translation, known as the Vulgate, is today the official Bible of the Roman Catholic Church throughout the world. It was also the basis of the earlier translations into English and other European tongues, and of the Douai English translation which is used by English-speaking Catholics. It is an interesting commentary on the interest taken in the Bible that when printing was invented in the 15th century, the Latin Bible was the first complete book printed.

Parts of the Bible were early translated into English. The first writer to do this was Caedmon, though it is true he did not translate the Bible at all in the usual sense, but sang its divine stories so the ignorant people of his time could understand them (see Caedmon). Other translators, including Bede, gave the peoples of England fragments of the scriptures in their own tongue, but it was not until the year 1382 that the whole Bible was translated into English.

Famous Translations of the Bible

This first English Bible, translated from the Latin Vulgate (1382) and copied out by hand, is considered by many to be the work of the group of early reformers headed by John Wyclif and bears his name. Great opposition arose to it because its authors were "heretics" and translated many passages in a sense not approved by the church. Nevertheless, it was so widely circulated that, in spite of the fact that its reading was prohibited by law, there are more than 100 manuscript copies of it preserved today.

William Tyndale, who was born a hundred years after Wyclif's death, went back to the original Hebrew and Greek versions, and his translation of

many passages is so good that much of it is preserved in the English Bible of today. But Tyndale too was a "heretic," and when the first of his books reached

England from the Continent they were burned as "pernicious merchandise." The new art of printing, however, spread his Bible far and wide. In the end Tyndale was condemned as a heretic on the Continent and he became one of the martyrs for the Protestant faith.

Miles Coverdale's Bible (authorized in 1535) was founded in part on Tyndale's translation; while the "Great Bible," ordered by Henry VIII in 1539 to be placed in all the churches, was partly based on Coverdale and partly on the work of John Rogers, later a martyr.

When James I came to the throne, the Reformation had been established in Great Britain and the church services were

all in English. He desired an English Bible more perfect than any then existing, so he instructed 47 biblical scholars to prepare a new translation. The result of their labors was the King James Version, published in 1611, which has been for 300 years the "authorized version" of the Protestant English-speaking people. It is the greatest book in the English language. "Its simple majestic Anglo-Saxon tongue," says one writer, "its clear sparkling style, its directness and force of utterance, have made it the model in language, style, and dignity of some of the choicest writers of the last two centuries, and its reverential and spiritual tone and attitude have made it the idol of the Christian church and endeared it to the hearts of millions of men and women."

For English speaking Catholics a similar place is held by the Douai Version. This was first produced at the University of Douai, in France, by Catholic refugees from England in Elizabeth's day. Dr. Gregory Martin, formerly of Oxford, played the chief part in the translation, which was revised by William Allen and others. The New Testament was published in 1582, and the whole Bible in two volumes in 1609 and 1610.

A HEBREW SCHOLAR READING FROM A SCROLL



Seated with a scroll before him, this venerable old man with the white beard is studying in the original Hebrew the faith of his fathers as recorded in the Old Testament. The scroll is unrolled with one hand as he follows it page by page, and rolled up with the other.

The Revised Version, made desirable by the discovery of new manuscripts, was published in 1881 by a committee of English scholars coöperating with a similar committee appointed in the United States.

Its translations are more accurate, but it lacks the beauty of language of the King James (or Authorized) Version.

In the early Christian Churches,—at Ephesus, Jerusalem, or Rome—say 50 years after the death of Jesus, the church services were secret because the Christian worship was forbidden by the law of the Roman Empire. After preliminary prayers and singing, amid a rustle of anticipation, the leader would turn to a great chest hung with silken curtains. Many scrolls of writings were in this chest, among them the sacred writings of the Jews, copies of letters from Fathers of the new church, and writings of Christ's own Apostles. If we could understand the ancient language, the passages read would all sound very familiar to us, for we have heard them over and over again in our churches and Sunday-schools. These scrolls or *biblia*, which is the Greek word for "books," have almost all been lost for hundreds of years. But before they were lost or destroyed, copies and translations were made of them, and from these was put together our Bible of today.

Establishing the "Canon"

The Old Testament as we know it is by no means the whole of the sacred writings of the Jewish people. It was not until 200 years after Christianity had been founded that the rabbis and teachers of the Jews finally decided which of their books should be regarded as "canonical" in the Jewish church. "Canon" means literally a rule or measure, and applied to the Bible it means a list of books which were accepted as inspired. These "canonical scriptures" of the Jews became the Old Testament of the Christians. But the early Christian church put 14 of these rejected books in a separate group at the end of the Old Testament. These we call the *Apocrypha*—the Greek word for "hidden," or the "hidden books." The Roman Catholic church still uses these Apocryphal books, but the Protestant churches do not recognize them. They include the books of Tobit, Judith, the remainder of Esther, the remainder of Daniel, the Wisdom of Solomon, Ecclesiasticus (called 'The Wisdom of Jesus, the son of Sirach'), Baruch, I and II Maccabees. All the leading English translations down to the King James Version included these books, and the scholars who gave us the Revised Version revised these books with the rest, although they were published in a separate volume. Some of the passages are equal in nobility to passages from the books included as inspired. Examples are: "Truth abideth and is strong forever; she liveth and conquereth forevermore" (I Esdras). "The souls of the righteous are in the hands of God . . . in the eyes of the unwise they seem to perish, but they are in happiness" (Tobit).

Similarly there was for a long time a difference of opinion as to what books should be included in the New Testament. There are no less than 109 of the New Testament apocryphal books, whose very names are unfamiliar to most Christians today; examples are the Epistle of Barnabas, the Teaching

of the Twelve Apostles, and the Shepherd of Hermas. The canon of the New Testament was not decided until 382 A.D. at a council of the church held at Rome.

The oldest manuscripts of the collected books of the Bible go back only to about 350 A.D. There are only a few of these and they are carefully guarded in libraries and museums. The oldest one of which we know is the Vatican manuscript, kept in the Vatican Library at Rome, which contains almost the whole of the New Testament. The Sinaitic manuscript, discovered in St. Catherine's convent at the foot of Mt. Sinai about 70 years ago, is in the library at Petrograd. It is also

very old, and contains the complete New Testament. The Alexandrine manuscript, written after 400 A.D., was presented to King Charles I of England and is now in the British Museum; it contains the greater part of both the Old and New Testaments. Some of these old manuscripts are called "palimpsests," owing to the fact that the original writing on the parchment sheets was erased to make room for later writing. Means have been found, however, to restore the old letters so that they show faintly through the lines of the later writing.

The New Testament was written in Greek. There are nearly 2,000 ancient manuscripts of the whole or different parts of the New Testament written in this language, but none is older than the manuscripts described above. In the past 30 years, however, in excavations made in Egypt, there have been found several pages containing "sayings of Jesus," which are probably a full century or more older than the oldest New Testament manuscripts we have. These priceless fragments of waste paper found in the shifting sands at the edge of an Egyptian town contain some teachings of the Master which are not recorded in the books of the New Testament as they later took shape.

The work of comparing such early manuscripts and correcting the text and revising the translation has gone on from early days. When the Temple at Jerusalem was burned in 70 A.D. much of the sacred literature of the Jews was lost; but a school of rabbis was formed at Tiberias to restore it. Alexandria in Egypt early became a center for the study of the Christian writings. All through the Middle Ages patient monks busied themselves with the labor of copying and so preserving the sacred texts. And with the publication of the printed Greek text of the New Testament by Erasmus in 1516, and by the Spanish cardinal Ximenes in 1522, the modern study of the Bible began.

Some Notable Bibles

One of the most beautiful of the Bible manuscripts in existence is a translation into Gothic by Ulphilas, the missionary to the Goths, which is now preserved in Upsala, Sweden. It has silver letters on purple vellum.

READING THE "GREAT BIBLE" IN ST. PAUL'S CATHEDRAL



This scene takes us back to 1540, when the new English translation of the Bible made by Miles Coverdale at the direction of Archbishop Cranmer and Lord Thomas Cromwell, and issued under the authority of King Henry VIII, was ordered placed in all the churches of England. The picture shows the eagerness with which the people availed themselves of the privilege to read and interpret the Bible for themselves.

The "Mazarin Bible" was the first complete book printed from movable types (1452-56). It is so named because the first copy discovered was found among the books of Cardinal Mazarin of France.

The "Complutensian Polyglot," published by Cardinal Ximenes in 1522, prints the Greek of the New Testament in one column and the Latin of the Vulgate in the other. For the Old Testament it gives the Hebrew on one side, an old Greek translation (called the Septuagint) on the other, and the Latin Vulgate between—"like Christ crucified between the two thieves," so the preface says.

The "Bug Bible" (1551) was so called because of the translation of Psalms xci, 5, which read, "afraid of bugs by night," instead of our present reading, "terror by night."

The "Breeches Bible" is an English version published at Geneva in 1560, and is named from its translation of Gen. iii, 7, which reads, "making themselves breeches out of fig leaves."

The "Wicked Bible," printed in England in 1631, left out the word "not" in the Seventh Commandment. For this error the printer was fined the equivalent of \$1,500.

The "Thumb Bible," published in 1670 at Aberdeen (Scotland), was one inch square and one-half inch thick.

The "Vinegar Bible" (1717) has as the heading of the 20th chapter of Luke "The Parable of the Vinegar," instead of "vineyard."

The "Devil's Bible" is the name given a manuscript of the Bible taken to Stockholm after the Thirty Years' War. It is beautifully written on 300 asses' skins, and legend says it is the work of a monk condemned to death, who by selling himself to Satan was enabled to save his life by meeting the condition that he should copy the whole Bible on asses' skins in one night.

The Caxton Memorial Bible was wholly printed and bound in 12 hours, in 1877, to celebrate the 400th anniversary of the introduction of printing into England.

One of the smallest bibles in the world was printed in Glasgow in 1901. Without the cover it is $1\frac{1}{4}$ by $1\frac{3}{4}$ inches, and seven-sixteenths of an inch thick, containing 876 pages and several illustrations. It is provided with a small magnifying glass which slips into a pocket in the cover.

BICYCLES AND MOTORCYCLES. The story of the two-wheeled "cycle" should perhaps begin in ancient Egyptian and classical times, for some use was made even then of a device which was simply two wheels, one behind the other, connected by a bar of wood. But the title "father of the bicycle" is usually given to a German, Karl von Drais, who in 1816 invented a "velocipede" of the type in which the rider rested his weight upon the frame and moved by kicking the ground with his feet, enjoying speed only when coasting down hill. Not until 1865, however, and in France, was the crank-driven velocipede invented; and to England, in 1869, belongs the credit of producing the first steel-rimmed, solid rubber-tired contrivance—now definitely named "bicycle"—which superseded the old wooden frame and iron-tired "bone-shakers" of the earlier days.

In the early bicycles the pedal operated directly on the front wheel, and so to gain speed the front wheel was for a time made enormously large, while the back wheel became simply a small steering wheel. In the

early '80's the front wheel was 60 inches and even 64 inches high. These wheels were very difficult to mount and required much skill to prevent the rider from taking dangerous "headers" from his elevated position. The so-called "star" bicycle with the little wheel in front, which was introduced in 1880, was only a slight improvement over this type.

Two inventions especially made the bicycle what it is today—the easy-riding pneumatic tires, and the low-hung "safety" frame, with wheels of equal size transmitting power from the pedal to the rear wheel by means of a ratchet and chain. Ball bearings, the spring saddle, and other improvements followed rapidly, and in time the price was cut from the \$100 and \$125 of the '90's to

about half those amounts. Then the bicycle became a truly popular and useful means of travel and recreation. "Cycling clubs" were organized and long tours were often made on the bicycle, bicycle-riding reaching the height of its popularity in the United States about 1895. While it is no longer so popular a sport, there is a steady demand for the wheel for everyday use, for delivering packages, for messengers and policemen, for use in the army, and for similar purposes.

Although the automobile has superseded the bicycle in many of its uses, it has also given it a new lease of life by suggesting its transformation into the "motorcycle." The motorcycle, which was first perfected in 1900, is merely the bicycle made heavier and equipped with a small gasoline motor. Like the automobile, the motorcycle has a gasoline tank, oil tank, clutch, starter, magneto, carbureter, spark and gas control, muffler, etc. (see Automobile). The first machines were equipped with a one-cylinder motor, but they now have two- and even four-cylinder motors. There are about 50 different makes in America and Canada. The motorcycle is used for many important purposes. Police are mounted on them for special duty in many cities, dispatch carriers in the army are equipped with motorcycles, and they serve many purposes in business. Often they are equipped with a side-car for an extra passenger or for delivery of goods; and improvements in their manufacture have added speed and made them more comfortable and better adapted for long-distance service. Bicycle and motorcycle races are popular, but motorcycle racing on the regular curved track often results in serious injury to the rider.

The "motor wheel" is a later adaptation of motor power to the bicycle which equips the ordinary bicycle with a small detachable gasoline motor. The operation of such a light motor machine is limited to use on smooth pavements, but it has proved a practicable means of travel in cities.



This is the little Bible referred to in the text. It measures without the cover, $1\frac{1}{4}$ inches by $1\frac{3}{4}$ inches, but you can read it very plainly by using the magnifying glass.

BIGHORN. In the early days the wild sheep called the bighorn or Rocky Mountain sheep ranged throughout the whole western mountain system of North America, from Alaska to New Mexico. They are becoming rare, but may still be found in the rocky plateaus of the Bad Lands of Dakota, and in greater numbers about the headwaters of the Yellowstone and thence northward.

The massive circling horns of the male, which give the animal its name, are coveted as trophies, and much skill and patience on the part of the hunter are needed to capture this wonderfully swift, agile, and tireless animal. Its flesh is generally considered to be the best of all western game. In most states, the bighorn is now protected by game laws. The color is tawny yellow in summer, changing to grayish-brown in winter. It is a sturdily built sheep, about 40 inches in height and sometimes weighing as much as 300 pounds. The horns often measure 42 inches or more in total length.

The bighorn must not be confused with the Rocky Mountain goat, or white goat, which is an entirely different animal. Scientific name of the bighorn, *Ovis cervina*.

BILLIARDS. No other game in the world requires such delicacy of touch, steadiness of hand, accuracy of eye, and iron self-control as the ancient game of billiards. Long practice enables the skilful player to control the motions of the balls with an accuracy that seems almost miraculous to the beginner. In fact, the really expert can do feats so far out of the ordinary man's reach that the English philosopher Herbert Spencer once remarked that to play billiards well was the mark of an ill-spent youth. Spencer enjoyed the game thoroughly, however, and was accustomed to relax his mind after a morning of hard work by an hour of billiards at his club.

The game has been played in many different ways at various times, and even today there are marked differences between the English, French, and American games. In America billiards is played on a table usually ten feet long and half as wide, having a very

smooth and level surface of slate covered with green baize. Around the edge of the table is a beveled rail cushioned with rubber, from which the balls rebound lightly and easily. Three ivory balls $2\frac{3}{8}$ inches in diameter are used, one of which is red and the other

two white. One of the white balls is distinguished by a tiny black spot. Each player chooses one of these white balls as his "cue" ball. This cue ball is driven by a cue, a leather-tipped wooden rod a little less than five feet long and varying in diameter from half an inch or less at the point to an inch or an inch and a half at the butt. Chalk is rubbed on the leather tip every few turns to make greater friction between cue and ball, thereby better control.

With the fingers of one hand the player holds the butt of his cue firmly but lightly; the other hand he places on the table so that the forefinger and thumb support and guide the forward part of the cue. The cue ball is struck with the point of the cue in such a way as to cause it to touch first one and then the other of the two remaining balls, thus making a "carom" or "billiard." Each billiard

counts one point in the score. By directing the point of the cue against a part of the cue ball to one side or above or below its center, it is possible to "put English" on the ball; that is, to make it twist or curve and thus make shots otherwise impossible.

One very effective way to score many points without missing is to "nurse" the balls; that is, to get them in a corner or along the rail and by hitting them very lightly hold them in one place for a long time. This easy way of running up a large score is made impossible in many professional games by marking "balk lines" 14, 18, or 22 inches in from the edges of the table, and by making the rule that either every second or every third shot must be hard enough to send at least one of the balls outside the marked square in which the balls are grouped when the shot begins. Any number of caroms are allowed in the square left in the center of the table.

BIGHORNS AT HOME



One habit of the Bighorns is to post sentinels. That magnificent creature in the rear seems to be on sentinel duty. In summer the Bighorns climb to the most inaccessible crags, feeling perfectly at home on dizzy heights where men could scarcely get a foothold.

"Pocket billiards" or "pool" is quite a different game. It is played on a table that has pockets in each corner and two extra ones in the center of the longer sides. In "straight" pool, the most popular of the many pool games, 15 balls and a cue ball are used. The players take turns using the same cue ball, the object being to put the 15 balls in any of the pockets. The player wins who pockets the greatest number.

Recently there has been an effort to strip these games of their frequently evil associations. Billiard and pool tables are now found in most clubs, and in many social centers, Y.M.C.A. buildings, church recreation rooms, and in many homes of well-to-do Christian families.

BILL OF RIGHTS. The idea of a bill of rights came from the English Bill of Rights passed by parliament in the year 1689. The first Bill of Rights was passed by the English parliament in 1689, when William and Mary were brought to the throne by the "Glorious Revolution." It declared illegal the tyrannies of James II, and guaranteed to the people a fair trial in the courts, frequent meetings of parliament and free-

dom of debate therein, freedom from taxation except by parliament, the right of petition, etc. Several of the first ten amendments to the constitution of the United States, including the one forbidding "excessive bail" and "cruel and unusual punishments," were taken almost word for word from this English Bill of Rights.

Following the example of Virginia in 1776, most of the states of the Union today begin their constitutions with a bill of rights setting forth the rights which the state may not take from the individual.

But the most important statement of such rights is the Declaration of the Rights of Man issued by the French Revolution in 1789. It laid down the principles of the freedom and equality under the law of all citizens and the sovereignty of the people, as well as the rights of the individual to freedom of speech, of religion, and of the press. It has well been said that it "laid down the principles of modern governments." This declaration soon passed beyond the frontiers of France and became an important factor in the growth of world democracy in the 19th and 20th centuries.

The WONDERFUL SCIENCE of LIVING THINGS

BIOLOGY. If a "man from Mars" were to come to the earth, he would be surprised at two things—at the amazing wonder, beauty, interest, and variety of living things, with the "oneness" of all earthly life, and that so many people remain blind to the fascination of the

living things which surround them. In the limits of this brief article, only some of the broader aspects of the science of living things can be considered.

Biology, in brief, is "the science of life." There are at least two million *kinds* of living things in the world. With all their irreconcilable contrasts—men, earthworms, jellyfishes, oak trees, ferns, seaweeds—they yet possess many features in common. All life is fundamentally one. And so we have the common great science of biology, which deals especially with the far-reaching fundamental characters of living things.

Of course this study is so vast that it is impossible for any one man to cover or master the whole field in detail. Consequently it is broken up into divisions, of which the primary ones are *botany*, the science of plant life, and *zoölogy*, the science of animal life; and each natural scientist further specializes in some narrower line, such as anatomy, physiology, embryology, genetics, or some other of a large number of such fields. But there is still place for the

HOW amazing are the revelations of Biology, which teaches the "oneness" of Life—throughout all its more than 2,000,000 earthly forms—earthworms and jellyfishes, apes and man, oak trees and seaweed! What magic there is in the stuff "protoplasm" from which all living creatures are formed; how fascinating is the study of embryology and the laws of inheritance; and how startling it is to learn that "all the people in the world at any one time have had their heredity carried by a total of less than an ounce of matter!" Here are presented the chief facts of the science of Biology, with an indication of its chief lines of advance in the past hundred years.

common science of biology, to take account of living things especially in their larger relations, and to correlate all of the many divisions of the subject.

The modern science of biology differs from the old-time "natural history" chiefly in that the latter was, in the main,

a great accumulation of disconnected facts about plants and animals. Biology, on the other hand, takes account of the detailed facts mainly as they illustrate the principles and laws that govern life. At present the term natural history is customarily used to apply especially to the out-of-doors study of the habitats, habits, modes of life, seasons, and activities of living things, both plants and animals. While this outside study of living things has its wonderful fascinations, the same is true also of the other phases of their study; but these take more patience, serious study, and often the use of the microscope and other facilities.

Common forms of life, of course, are easily divided into the two great types—plants and animals—with clear distinguishing characters for each. At the bottom of the scale of life, however, the plant and animal kingdoms converge, and there are some simple microscopic forms which are not clearly one or the other, but possess some characters of each. And so it is impossible to draw a sharp line between the plant

and animal kingdoms. But between clear-cut plants and animals, the following are the main differences:

Green plants are able, in the presence of sunlight, by means of their green chlorophyll, to utilize salts and water drawn from the soil, and carbonic acid obtained from the air, in building up their own substance.

This cannot be done by man artificially, or by animals naturally. In this way green plants furnish the fundamental food supply, not only for all animal life in the world, but also for the colorless fungus plants such as mushrooms and molds. In this wonderful work the green chlorophyll is the "machine" that does the work; the sun's rays furnish the radiant energy that is transformed into chemically stored energy in the form of starch, sugar, and the other energy-yielding foods of man and all other animals. Less important differences are: The cells of plants have walls of woody material, of animals not.

Plants are usually stationary; most animals move freely from place to place. Most animals have a nervous system and sense organs.

The Stuff that All Life is Made Of

But with all these differences, it still remains true that both types of living things possess the main fundamental characters of life in common. In all organisms, the living substance is *protoplasm* (see Protoplasm). And while there must be infinite variety of tissue, as found in different plants and animals and in different parts of the same plant or the same animal, protoplasm is the same fundamentally everywhere, and differs only in details. It contains the same 12 chemical elements (carbon, oxygen, nitrogen, hydrogen, sulphur, calcium, potassium, magnesium, iron, phosphorus, chlorine, and sodium), and contains none that are not common in nature everywhere. Protoplasm possesses everywhere the same general physiology; is sensitive to external conditions, such

as touch, temperature, chemical, etc.; there is some form of response, especially apparent in the motion of animals. All organisms utilize food and grow; possess respiration, the taking in of oxygen and giving off of carbonic acid; and reproduce their kind in some form of reproduction. One of the most extraordinary and important resemblances is the striking and intricate method of cell division (see Cell).

In viewing the life of the world, it is always fascinating to think of the combination of the great number of conditions that are necessary to make life possible on earth—all of them necessary.

One thinks first, perhaps, of the sun and its rays, bringing light and warmth, often forgetting that the sun is also the sole source of all the energy for plant growth and for the food supply for the whole living world. And so it was, through the many million years of the infinite past, while Nature was slowly and

patiently depositing the vast storehouses of energy in the form of coal, oil, and gas, for the uses of modern man—all derived from the remains of the plants and animals of the past! Vast quantities of *water* are also absolutely necessary. Water forms the larger part of protoplasm and is the universal solvent for the foods of both plants and animals. The water vapor of the atmosphere furnishes a blanket that helps to retain the heat from the sun. The vast reservoirs of the sea help to stabilize the temperature of the earth. An *atmosphere* of moderate temperature, with oxygen for respiration for all life and with carbonic acid for plant food, is absolutely necessary, as are also all of the *chemical elements* that enter into the formation of protoplasm. Other conditions, more difficult to explain, are also necessary for life as we know it.

Is there Life in Other Worlds?

All in all, life in our world is possible only by the combination of so many and such peculiar conditions

THE STORY OF THE TRANSMISSION OF LIFE

IN thinking of living things it is most important to realize that they are all made up of tiny units of protoplasm which we call "cells." These cells are of many kinds, each with a special task to perform. There are blood cells to carry oxygen from the lungs to all parts of the body, muscle cells for movement, gland cells to produce digestive juices, nerve cells to convey messages back and forth. But all of the cells that form a plant or an animal have come from a single cell at the beginning of its life. By a beautiful and mysterious process this single cell divides into two, and each of these into two—always two—and so on, until there have been formed the millions and millions of cells that make up its body.

Within the walls of each cell is a nucleus containing tiny threads of a substance called "chromatin." This chromatin is the most wonderful of all living matter, for it controls all life. The picture on the opposite page shows how the chromatin threads form tiny rods, which split in halves. It shows how these halves divide into two equal groups, and how each of these groups becomes the center of a new cell. The cells of an acorn multiply into a giant oak in just this way, and when you use up muscle cells in work or in play, new cells to take their place are produced in the same manner.

But more wonderful still is the process at the beginning of a new life which keeps the vital flame burning. Consider a flowering plant, for instance. Down in the flowers, sheltered from harm, are many tiny delicate egg cells—the mother cells. A gust of wind, or an insect roving in search of nectar, brings to one of these a pollen grain from another flower. This pollen grain is the father cell. Left alone by themselves the mother cell and the father cell would die. But now the chromatin in the tiny father cell, following a mysterious instinct which lies at the very heart of life's secret, grows down into the flower and unites with the chromatin of the mother egg cell, and fertilizes it. At that moment the new life of the plant begins. The fertilized cell divides again and again, as described above, until it forms the tiny embryo plant, which lies folded up within the seed and is ready to unfold and grow when the seed germinates.

The process is similar among animals,—a single tiny male cell penetrates and fertilizes an egg cell, and causes it to develop into a new animal. Half of the chromatin in that first fertilized cell is given by the mother and half by the father. That is why the new life resembles both parents. As the cells go on dividing, each of them has material from both of the parents.

Can you think of anything more wonderful than this strange power, locked up in a cell so small that the eye can't see it—the power to multiply and create bone and muscle, nerves and brain, the power to create new life, and to carry over to that new life those complex details of face, features, complexion, and even of mind and character which the parents possessed?

THE MOST WONDERFUL OF ALL LIFE'S PROCESSES



Here you see Nature's way of developing a new life from a fertilized egg. In the upper left-hand corner is a cell, enormously magnified. The sphere in the center is the "nucleus." Those black rods shaped like bent pins inside the nucleus are "chromosomes." They are made up of the wonderful substance called "chromatin," half of which comes from the mother and half from the father. On the edge of the nucleus are two black specks called "centrosomes." This first cell shows us the very beginning of life. Now watch that tiny life grow! In the upper right-hand corner the centrosomes have separated to opposite poles and a delicate arrangement of fibers has been formed to which the chromosomes have attached themselves. The cell in the center shows the most wonderful stage of all, for it tells us the secret of heredity. See how each of the chromosome rods has split lengthwise into exactly equal halves! In the next cell at the left, half of each rod has been pulled away from the other half by those centrosome fibers, forming now two separate groups, each made up of mother and father elements alike. In the last picture the cell walls have split, forming two new cells like the first. These will in turn split into two, and so again and again, and the new life will grow to become a plant, or a fish, or an elephant, or a man, depending upon the nature of the parent chromatin.

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that it seems to us there can be no life in other parts of the universe without the same combinations—a benevolent sun, an atmosphere, vast quantities of water, etc. Given these, however, is there life in other parts of the universe? Nobody knows! But why not? It may be of course that there are not the same types we know—that there may be insects with four pairs of legs instead of three, and three pairs of wings instead of two; and humans with three pairs of limbs instead of two. You may imagine almost any forms you like; but nobody knows anything about it.

Space will permit but a few general considerations of the distribution and interrelations of living things in the world. In general the variety and wealth of *plant life* is on land, of *animal life* in the sea.

The Life of the Land and the Life of the Sea

All are familiar with the general conditions of life in the field and woods. The liberal vegetation, mostly of flowering plants, furnishes the fundamental food supply for animal life—insects, birds, mice, rabbits. Even where predacious animals feed on other animals, the latter have fed on plants. The interrelations—"the web of life"—are extremely intricate. And so it is, in greatly magnified degree, in the tropical forest. One thinks there of the luxuriant dense matted vegetation, sheltering its teeming life of insects and tropical birds and other strange life of the jungle. Here the web of life is so intricate as to baffle the imagination.

In the sea all is different. While there is often much *plant life* in the form of seaweeds (flowerless plants), especially along rocky shores, the wealth of plant life of the open sea consists of the invisible microscopic forms, especially the *diatoms*. About the *animals* of the sea there is always a peculiar fascination due to their abundance, their variety, and their strangeness. They are everywhere. Even the colder seas are populated by immense numbers of marine animals in great variety. Often along the shore—rocky, muddy, sandy—there is a baffling wealth of animal life the world over. The open sea has many peculiar forms at the surface, and still more peculiar ones at the bottom, even down as far as five miles. Fishes that are half mouth; crabs and their relatives that are mostly legs and feelers; starfish and their numerous relations; even delicate jellyfishes and polyps are there. And think of the conditions at these great depths—the tremendous pressure of five miles of water; the icy cold, even in tropical seas; the absolute darkness, except that a good many forms are phosphorescent—for not a ray of light penetrates much beyond a few hundred feet; the absolute quiet—for waves penetrate but a few feet.

All of the food and energy for this animal life at the bottom of the sea is from or near the surface, and consists of the microscopic forms of plants, or the small animals that have fed upon them. Over perhaps a hundred million square miles of the sea bottom is a deep "ooze," consisting of the skeletons of micro-

scopic animals and plants that have rained down through the ages from the surface.

Many forms of life are peculiar to the sea. Whole branches of the animal kingdom are found here alone and have never found their way into fresh water. Such are all the various forms of starfishes and their relatives; almost all of the great branch which includes the jellyfishes and polyps; almost all of the sharks; and other branches which might be named. Most of the life of the sea is fed, ultimately, by the microscopic plants that grow at the surface. Upon these tiny plants feed microscopic animals and small crustacea, even some fishes; these in turn feed the larger animals, including fishes like the cod and sharks, and whales and porpoises and other cetaceans.

Lives that Live on Other Lives

Among the most interesting and important of the biological interrelations of organisms is that of *parasitism*. There is scarcely a common form of life but has its many parasites. We think usually of the worms of many kinds that infest the intestine of man and most backboned animals; and of the insects, and other parasitic forms in or on the bodies of most visible forms of both plant and animal life. But the most deadly parasites for man and many other animals are the infinitely small microscopic *bacteria* of the plant world, and the *protozoa* among animals. It is they that kill most of mankind and other animals, and cause the rusts and smuts of grains, and the rots and blights of fruits and vegetables. Not all bacteria, however, are bad. Many are harmless, and many are of great service in tearing down and getting rid of the dead bodies of larger animals and plants that would be in the way if not removed (see Bacteria; Parasites).

The Mystery of Life's Beginnings

Two or three branches of biology deserve special mention because of their significance and suggestiveness. One of the most fascinating and mystifying is the study of the reproduction and development of animals and plants—their *embryology* (see Embryology). The coming into being of an organism, especially one of the higher animals, remains one of the unsolved mysteries. Of course, it is popular knowledge that the common forms of life arise from fertilized egg-cells, but it may not be so well known that this is just as true for an earthworm or an oak tree as it is for a man or a chicken. It is true for the whole living world that "like begets like"—that all plants and animals, simple as well as complex, arise only from parents like themselves. The simplest forms of animal and plant life consist of a single cell; and they multiply merely by the single cell cutting itself in two, as described for the amoeba (see Amoeba). It seems hard to realize, however, that a human being, with its infinitude of characters, can arise from a tiny egg only a hundredth of an inch in diameter. It seems wonderful, too, that of three eggs, so nearly alike in size and appearance that it is difficult to tell them apart, one may give rise to a

ALTITUDE RECORDS IN THE ANIMAL WORLD



Biology teaches us that living creatures can adapt themselves to widely different conditions of life, if they are given a chance to acquire new habits slowly from generation to generation. Here we see how various kinds of animals have become accustomed to altitudes ranging from sea-level to many thousand feet on the mountain slopes. But you must not imagine that the "higher-ups" have any advantage over the "lower-downs." The Yak of the Tibetan plateau, for instance, could no more get along in the lowland jungle where the Orang-Utan lives, than the Orang-Utan could live in the Yak's lofty home. You will notice that the Condor, that great South American bird, is given the highest place. This is really an honor he doesn't deserve, for, while the Condor flies over the highest peaks of the Andes, he doesn't really live there, but nests much lower down. The Yak, after all, holds the championship, for in the wild state he is found on mountains in Tibet, where few human visitors could long stand the rarefied air. It may surprise you to find the African Elephant and the Baboon so high up in the world. But remember that it is not nearly so cold at such heights in equatorial Africa as it is on the low frozen shores where the Polar Bear is found. An example of biological adaptation is provided by the Woodcocks. The Asiatic member of the family finds himself comfortable at 17,000 feet, but his European cousin seldom lives above 7,000 feet. While the Cat family as a rule flourishes best in lowland climates, the Siberian Tiger ranges as high as 10,000 feet, doubtless lured there in pursuit of prey which sought to avoid him by fleeing higher. His long soft fur is a better protection against cold than the shorter coat of his Bengal brother.

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starfish, one to an earthworm, and the third to a human being. In reality these three eggs are very different from one another.

The origins of the higher forms of life seem so natural to us now that it is hard to realize that people formerly believed that even complex animals, such as earthworms and frogs, arose by "spontaneous generation," that is from non-living matter, without parents. It is only in recent years, however, that science has *proved* that the origin of life is the same for the simplest forms as for the highest—for the infinitely small germs of tuberculosis or malaria, and the whole multitude of plant and animal germs that have heretofore killed a large majority of mankind, as for mankind itself. At present it can be said that man has never created even the simplest form of life, or seen it arise spontaneously. Of course, a Burbank can perform wonders in *modifying* the common forms of plant and animal life, but can never create it.

"His Mother's Eyes and His Father's Chin"

Genetics, the study of the laws of inheritance, is the newest branch of biology, and dates back only about 20 years. Since then it has been very much studied for there are "fashions" in science as well as in most human affairs. In 1900 it was realized that Gregor Mendel, an Austrian monk, working with peas nearly 40 years before, had discovered some general laws of heredity of very great importance and very wide application. The amazing thing is that Mendel's laws, found for peas, have since been found to hold good for many highly specialized plants and animals, even for some of the characters of man himself—such as the color of his hair and eyes, etc. How wide the application is, especially for man, has not yet been fully determined. While Mendel's laws do not apply to all characters of plants and animals, they are known to be of sufficiently wide application to be of very great importance in the improvement of domestic plants and animals.

It is common knowledge that plants and animals inherit the minutest characters from their parents. The amazing thing is that all the infinitude of these characters, large and small, are carried by an unbelievably small amount of matter in the fertilized egg. *Science tells us that all of the people in the world at any one time have had their heredity carried by a total of less than an ounce of matter!* Think of the wonder of the development of a human being, with all his infinitude of characters—his features, color of his hair and eyes, temperament, traits of character, and ability! Or of a great redwood tree, that is to live for several thousand years!

Stories that the Rocks Tell Us

Many plants and animals with hard parts have left remains in the rocks of the earth's crust which are called "fossils." The study of such remains is a branch of biology called *paleontology*, although this study is oftener connected with geology, the science of rocks. Paleontology more than any other science shows us the history of life in the world, through all

of the millions of years of the infinite past. One of its most interesting revelations is that there are many forms of life that developed and flourished for ages, and then entirely disappeared from the earth. These include giant lizards more than 50 feet long; grotesque monstrous mammals; giant mosses the size of trees (*see Animals, Prehistoric*). It shows us the stages in the evolution of the horse, from ancestors the size of foxes. A thousand appealing things are shown by the study of fossils. Large parts of some kinds of rocks are formed by these remains of plants and animals. The great deposits of chalk, for example, often thousands of feet thick, consist almost wholly of the skeletons of microscopic animals.

The Great Discoveries of Recent Years

Several phases of biology may best be referred to by a brief history of the science during recent times. Great improvements in the microscope, as well as other improvements, along with the growth of science in general, made possible enormous advances in the science of biology during the 19th century. By far the larger part of what is now known of this subject is *recent* knowledge, amounting to a revolution in the science.

(1) One of the first of these great advances was the realization that all plants and animals are made up of *cells*—that the cell is the unit of structure in all living things. In the simplest forms of life, both animal and plant, the whole organism is but a single cell. In all higher forms of life, man for instance, the body is composed of millions and millions of cells, of many kinds, each kind specialized for some special use—muscle cells for motion, gland cells for secretion, etc.

(2) Following shortly upon the statement of the cell theory was the recognition that the essential part of a cell is its jelly-like substance, which we now call *protoplasm*, and that this material is much the same in all living things, although differing infinitely in details in different types of animals and plants, and in different parts of the same complex organism. When the egg develops into the human body, for instance, the protoplasm gradually becomes different in the various types of cells.

(3) The greatest advance in biology followed Charles Darwin's statement of the doctrine of *organic evolution* and the publication of his 'Origin of Species' in 1859. The rapid acceptance of the view that living things are changeable, and that the diversified forms of life—of both animals and plants—have arisen by gradual changes from simpler forms, has had a very profound influence upon all fields of biological study (*see Evolution*).

(4) *Physiology* is the study of properties, activities, and functions in living things. Formerly it was limited almost wholly to man, and was mainly a part of medical study. With the general growth of biology, physiology has been extended to the study of all living things. This has brought great benefit to medical science itself, for a large part of what is

now known of human physiology was first worked out upon frogs, cats, dogs, rabbits, etc. Fuller knowledge of plant physiology also has been of great benefit to agricultural science in recent years.

(5) Between 1865 and 1890 came many revolutionary discoveries by Pasteur and other workers, showing that *fermentations* and *putrefactions* are always caused only by minute organisms, and that these are always introduced from the outside, and never arise spontaneously (see Pasteur, Louis). It was soon realized that most of the diseases of mankind and other animals are caused by these infinitely small animal and plant parasites which we call *germs*. As applied to human living and well-being, no other discovery has ever been of such far-reaching importance. (See Germ Theory of Disease.) The whole fabric of health and disease hinges upon this knowledge, and the medical and surgical sciences have been revolutionized by it.

(6) The science of *genetics*, which deals with the laws of inheritance, has already been sufficiently covered in what has been said above.

It should always be remembered that any science, any field of human knowledge, grows by the labors and sacrifices of thousands of men, whom an unthinking and ungrateful world often forgets. Partly these discoveries are made by men who have in mind their practical use in "applied science"; partly they are made by men who work and advance science just for the sake of increasing man's knowledge of the world in which we live. Often the discoveries of the latter class in "pure science" prove to have revolutionary importance in their practical applications. Such were some of Pasteur's discoveries which helped to revolutionize medicine, though he was not a physician at all, but a chemist and biologist, and which made him perhaps the greatest benefactor of mankind in the 19th century.

BIRCH. Beautiful and graceful as a forest nymph, with its paper-white bark, slender spreading branches, and delicate foliage, this tree is widely distributed through North America, Europe, and Asia. There are several species of birches, most of them hardy and rapid of growth, though many of them are short-lived. The wood is hard and close-grained and is used for making furniture and for various manufacturing and building purposes; it also makes excellent fuel. The bark is much more durable than

the wood because it is impermeable to water, and long after the fallen trunks have rotted away, the encircling bark remains sound and intact. Baskets, boxes, and many useful and fancy articles are made

THE NYMPH-LIKE GRACE OF THE WHITE BIRCH



How graceful, how they suggest the Greek spirits of the wood! A moment ago they were dancing with their filmy draperies weaving lines of beauty in the air. Then they saw us coming and suddenly stopped stock still and pretended to be trees! On the left are the leaves with their catkins, and also with their broad winged seeds.

from the bark, as well as the birch canoes of the American Indians.

The American white birch, which is native to the northeastern part of the United States and Canada, is a beautiful and plucky tree, springing up in deforested wastes and in abandoned fields. It seldom exceeds 45 feet in height. The bark is smooth and white, not peeling readily as does the bark of many other species.

The "canoe" or "paper birch" is one of the largest and most picturesque of the genus and is widely distributed throughout the northern states. Its usual height is about 60 to 80 feet though it sometimes attains a height of 120 feet. The bark is chalky white in color, and tears off readily in horizontal sheets. This tree was valued highly by the Indians, who made from it their birch canoes, as well as bark baskets, buckets, dishes, and many other utensils.

Another species, the cherry, black, or sweet birch, is a comely and useful tree which grows from 50 to 80 feet high and has dark brown bark covered with wart-like spots. Early in the spring it glows with yellow catkins, and in the summer it has an abundance of glossy foliage which turns golden yellow in autumn. From the sweet sap of this tree birch beer is made, and children chew the tender twigs for their flavor.

Scientific name of American white birch, *Betula populi-folia*; of canoe or paper birch, *Betula papyrifera*.

Our CHARMING NEIGHBORS in FEATHERS



The Fascinating Story of the Lives, the Loves, and the Homes of One of Nature's Most Interesting Families, and how it Developed from the Reptiles

BIRDS. Of all animals birds are the most easily defined, because they are the only ones which bear feathers. The feathers are outgrowths from the skin, like the scales of reptiles or the hairs of mammals, but they are much more beautiful adaptations to the life which the birds lead (see Feather).

Birds, with the fishes, reptiles, amphibians, and mammals, make up the division of the animal kingdom known as *vertebrates* or backboned animals. Because of the modifications necessary for flight, however, the backbone of a bird, like the rest of its skeleton, seems very different from those of the other vertebrates. If you examine the skeleton of a bird and compare it with that of a reptile or a mammal, you are impressed by the way in which nature makes over structures to suit different needs. Birds are believed to have evolved, during geologic times, from a reptile-like ancestor; and the differences in their structure which seem so great today have been brought about by the birds learning to fly. Birds today do not have teeth, but many fossil birds had teeth, just as their reptile cousins still have.

How Nature Built the Bird for Flying

The framework of an airplane or any flying machine must be very strong and compact and at the same time very light. A bird is a flying machine, and its skeleton is its framework; and the more we examine it the more impressed we become with the wonderful way in which nature has transformed each part to adapt it to the bird's needs.

The backbone for example has been shortened, and the separate vertebrae of the trunk have been fused with each other and with the pelvis to give it greater strength. The ribs are firmly attached to this and also to the breastbone, and

they have overlapping appendages to give the trunk great solidity. All of the bones are hollow, to give them the greatest strength for their weight.

In an airplane the engine and the passengers and all the heavy parts are placed as near the center of gravity as possible, and with a bird it is the same. The outlying parts, such as the head and tail, wings and legs, are made extremely light, and the heavy muscles that work them are attached to the trunk, only the tendons extending to the outermost parts. When one examines the skull he is immediately impressed with the thinness of the bones. There are no teeth, and the jaws, therefore, need not be heavy; for the work of mastication, which would require muscles and weighty bones, is performed by the gizzard, a modified portion of the stomach, located near the center of gravity. When we examine the tail, we see that the numerous vertebrae which make up the tail of a reptile are all shortened and fused into one little bone called the *pygostyle*. One is quick to notice that the largest muscles of the legs are located about the thigh bones, which are held close against the trunk and thus near the center of gravity. As if to make up for the shortening of the leg which this position causes, the ankle and foot bones are fused and drawn out into a long slender bone called the *tarsus*,



Give him time! Give him time! You can't expect that young Robin to swallow 14 feet of earthworm all at once! But a little robin can and does eat 14 feet of earthworms every day—taking a worm or a piece of one at a time, you understand, as mother supplies it.

For any subject not found in its alphabetical place see information

which is the only part of the leg that usually shows below the feathers, and to which the toes are attached. When we examine a bird's wing, which is nothing more



One of the very earliest of the early birds, the Archaeopteryx, now found only as a fossil. The reptile relationship can clearly be seen in the teeth in both jaws and the three claw-bearing fingers on each wing.

than the bird's arm or front leg modified for the particular purpose of flight, we see how few heavy muscles are borne upon it. The strong muscles that manipulate the wings are attached to the keel of the breastbone, forming the familiar meat of the fowl's breast, and are thus brought close to the center of gravity. The unnecessary bones of the wrist and hand are fused, only

one finger remaining well developed, though traces of two others have been retained. Thus we might go on examining every part of the bird's anatomy, and we should discover in each case that while the original reptilian parts are still recognizable, they have been transformed through the course of evolution to make the bird a perfect flying machine.

Why the Reptile's Blood Turned Warm

Another great difference between birds and reptiles is that birds, in common with the mammals, are warm-blooded animals. The chief difference between warm-blooded and cold-blooded animals is that the warm-blooded have a constant temperature, while the temperature of the cold-blooded animals varies with that of their environment. It is for this reason that reptiles become very sluggish in cold weather, a characteristic that would not fit in well with the needs of a flying bird. We may assume, therefore, that one of the most important changes that took place in the development from the reptile was the change from a cold-blooded to a warm-blooded condition. This change brought with it many accompanying changes in the life of the bird, for it ordained that the bird's eggs, also, should be maintained at a constant temperature, and that the temperature of the young should not fall below normal. This resulted in the need for "incubation" of the eggs, the building of nests, and the care of the young, which form such a conspicuous part of the bird's life today. This is likewise

one of the fundamental reasons for the comings and goings or the "migration" of birds, which makes their study so fascinating; for if they were still cold-blooded animals they would undoubtedly "hibernate" during cold weather. It is also the reason for their insatiable appetites. It is because Mother Nature developed in them a bodily temperature much higher than that of man that their life processes go on at a much more rapid rate, causing their ceaseless search for food.

The eyes of birds are very highly developed, so that they can see great distances and follow rapidly moving objects. Thus a swallow or a night-hawk dashing through the air at breathless speed is able to keep its eyes on a tiny insect which is also moving rapidly. The eagle or vulture, soaring almost out of sight in the air, will dart with the speed of a bullet to a tiny object a human eye would hardly notice at a distance of a hundred feet. Likewise birds can adjust their eyes for different distances much more quickly than can other animals.

What We Owe to Our Feathered Friends

This ceaseless search for food gives birds their great economic value, for it enables mankind to compete with the hoards of insects for mastery of the earth's surface. "Without the birds, not only would successful agriculture be impossible, but the destruction of the greater part of the vegetation would follow." We can appreciate the meaning of this statement by H. W. Henshaw, former chief of the United States Biological Survey, if we stop to consider the great reproductive capacity of most insects, particularly those that feed upon vegetation and are therefore dangerous to crops.

The common potato bug, if left undisturbed, is capable of producing 60 million offspring in a single season. A common plant louse, which brings forth living young, has such a short life cycle that there may be 13 generations in a single season; and inasmuch as each female brings forth at least 50 young, the number in the 13th generation alone would be 10 sextillion. If left undisturbed and given plenty of food, it would take any insect only a few years to completely cover the earth with its offspring. The need of birds and other enemies of insects is, therefore, very apparent.

The astonishing



The Hoatzin of the Amazon Valley is the nearest living approach to the Archaeopteryx. The young have claws on their wings with which they climb about the trees.



When the Hoatzin (also called the Ama) grows up, the wing claws are shed and the bird looks much like a pheasant. This remarkable bird is a native of the Amazon Valley.

number of insects consumed by birds has been revealed by scientists in several ways—first, by watching individual birds in the field through high-power glasses and counting the insects eaten; secondly, by examining the contents of crops and stomachs of birds that have been shot while feeding; and third, by watching the life of the birds at their nests and observing the food brought to the young. As examples of the first method, a scarlet tanager was watched feeding in a tree infested with gypsy moths, and in 18 minutes was seen to consume 630 caterpillars. A northern yellowthroat was watched feeding in a birch tree infested with plant lice, and in 40 minutes was seen to pick off 3,500 of the little insects. As examples of the second method, the contents of a few stomachs examined by experts in the Biological Survey at Washington may be listed. Of two yellow-billed cuckoos examined, one contained 217 fall web-worms and the other 250 tent caterpillars. Of two night-hawks examined, one contained 60 grasshoppers and the other 500 mosquitoes. The crop of a cedar waxwing contained 100 canker worms, and that of a flicker contained 1,000 chinch bugs. As examples of the third method, a pair of chickadees were observed to feed their young 40 times in 30 minutes; a pair of purple martins fed their young 312 times in a day; and a pair of rose-breasted grosbeaks fed their young 426 times in 11 hours. The most remarkable case of feeding on record is that of a house-wren, which fed its young 1,217 times in 15 hours and 45 minutes. It has been shown by experimenting with young birds that they require from one-half to their full weight of food every day in order to grow. Thus a young robin,

when leaving the nest, required 14 feet of earthworms to keep it satisfied.

Other Things the Birds Do for Us

It is not only by the destruction of insects that birds play an important part in the economy of man.

RIVALS OF THE AIR



Man learned to fly by modeling a machine along the same lines as the body of a bird. The similarity between the airplane and the Sea Gull is shown here in a striking way—the same method of steering with the tail, and of turning up or down the rear edges of the wings for maneuvering. While the Gull can twist and turn through the air more deftly than the flying machine, the latter can beat any bird in a straight-away race.

Many of them derive a large part of their food from the seeds of weeds, and so help in keeping down these pests also. Here again the amount which they consume is remarkable. From the crops of two bob-whites, for example, were taken 1,700 and 5,000 weed seeds respectively, while two mourning doves yielded 7,500 seeds of sorrel and 9,200 seeds of pigeon grass.

A third way in which birds help man in his pursuit of agriculture is by eating the small rodents which are very destructive to grain and forage crops, and which frequently do thousands of dollars' damage in winter by girdling fruit trees. The common meadow mouse is so prolific that in five years, if all the offspring of a single pair lived, they would number several million. It is

therefore necessary to have some natural check upon their numbers, and nature has provided the hawks and owls. Each hawk or owl requires the equivalent of three mice a day in order to live, or over 1,000 a year. These birds, therefore, have a considerable money value to the farmer upon whose land they take up residence. It is a noteworthy fact that following the so-called "plagues of mice," when these pests overrun districts by the thousands, there is always a flight of owls, usually of the short-eared species. Nature seems to take this method of regaining her balance.

A fourth way in which birds serve man is as game.

Certain birds, such as the grouse, pheasants, snipe, woodcock, ducks, and geese, seem to serve man best by providing him with invigorating sport and food for the table. None of them are particularly important as a destroyer of insects, and many of them become even harmful to agriculture if they occur in large numbers. Such birds are naturally prolific, and when properly protected by game laws are able to withstand, in suitable localities, the losses which they

small fruits, so that early strawberries, raspberries, and cherries often suffer from their depredations. Where there is a plentiful supply of the native fruits, however, or where many mulberry trees have been planted, the cultivated fruits are left alone. Other birds, that customarily feed upon weed seed, often prove destructive in grain and rice fields, so that it is necessary to frighten them away. Blank cartridges are as effective as the loaded ones, and they have the

FIVE HIGHWAYMEN OF THE AIR



It all depends on your point of view whether you consider these feathered bandits as your friends or your foes. The Crow, for instance, at times eats the eggs of other birds and kills their young in the nests; but he also destroys an enormous number of harmful insects, and expert agriculturists look upon him as a benefit to the farmer. The Great Horned Owl will occasionally dine on a young chicken, but his usual fare consists of field mice which are enemies of crops. Not so much can be said for Cooper's Hawk and its smaller relative the Sharp-shinned Hawk, for these live chiefly on birds and poultry. The Shrike, on the other hand, destroys great numbers of grasshoppers, mice, young snakes, frogs, etc., as well as an occasional sparrow. His habit of pinning the bodies of his victims on thorns has won him the name of "Butcher-Bird."

receive. Certain species, like the ring-necked pheasant and mallard duck, are being bred in captivity in large numbers and released where the natural supply of game has been greatly depleted. The subject of game breeding is receiving more and more attention in this country, and is being encouraged by legislation so that in a few years it will undoubtedly offer an inviting occupation to young people interested in birds.

Although practically all birds are valuable to man in some one of the four ways mentioned, there are a few that usually prove troublesome at certain seasons of the year. Most birds, for example, are fond of

advantage of preserving the birds to feed upon the insect pests the following spring and summer. Crows, hawks, and the great horned owl are enemies of the poultryman and the game breeder, but otherwise they serve an important function.

The Delights of Bird Study

It is not merely because of their economic value, however, that birds are so extensively studied all over the world. Their cheerful songs, their bright colors, their many pleasing ways, serve to draw thousands of people from lives of confinement or inactivity into the woods and fields, in the pursuit of recreation that is as health-giving as it is fascinating. Those who are

unable to go far afield can, by suitably planting their grounds or offering food and water, attract dozens of these little feathered sprites close to their windows, where they can with little effort watch their many amusing and interesting ways and hear their cheerful songs. Though we may fix the dollar value upon the insects devoured by the little song sparrow, we can never estimate the wealth which his cheerful song brings to those that have an appreciation of birds. And it is the small birds who are the singers generally, while the large ones are of little or no importance as songsters.

The Geography of the Bird World

As soon as one begins to observe birds he discovers that the different kinds are found in different sorts of places. Some, like the robin and bluebird, are widely distributed in woodlands, orchards, and gardens throughout the country from Alaska to the Gulf, while others are restricted to certain localities or to particular environments. Thus the Ipswich sparrow nests only on Sable Island, Nova Scotia; and the Kirtland's warbler is found, during the summer, only in the jack-pine woodlands of central and northern Michigan. If one wishes to see rails, gallinules, and coots he goes to the marshes; and if he wishes to see bobolinks, meadow-larks, and vesper sparrows he goes to the upland fields. The study of *local distribution* offers many interesting problems to the amateur as well as to the scientific ornithologist.

The study of the distribution of birds over the surface of the earth, or their *geographic distribution*, offers many other difficult and fascinating problems. If the world should be charted according to its families of birds rather than according to its races of people or its governments, it would make a strange map, because all the birds of the Northern Hemisphere are more closely related to each other than are the birds of many adjacent islands of the East Indies. Six main divisions or geographic regions have been recognized by ornithologists, as follows: New Zealand, Australian, Neotropical (South America) Indian, African, and Palearctic (North America, Europe, and northern Asia). While a few birds are found all over the world, and others in two or more of these regions, the vast majority of species and many whole families are restricted to some one of these geographic regions. In traveling around the world, therefore, one would expect to find greater difference between the birds of North and South America or between those of Europe and Africa than between those of Europe and North America. When we study the birds of the East Indian Islands, we discover some of the strangest facts of distribution, for a part of the islands lies in the Australian region and a part in the

Indian, and the line between the two is very sharp. Thus the islands of Bali and Lombok (in the Malay Archipelago just east of Java), though but 20 miles apart, differ as greatly in their animal life as do Africa and South America, indicating that the two islands have never been united and that the deep strait separating them marks the dividing line between what was formerly the Australian continent and that of Asia—Bali belonging to Asia and Lombok to Australia.

In consideration of the geographic distribution of birds, the home of each species is considered to be that place where it builds its nest and raises its young, but many species migrate with the change of seasons from one region to another. Thus many of the North American birds spend the winter in South America, but do not nest there.

The Wonders of Bird Migration

In all the fields of Nature study you will find nothing more wonderful than this seasonal migration of birds. The little bobolink that visits the northern United States in summer, travels 5,000 miles over land and sea to his winter home on the pampas of southern Brazil. The golden plover wings a 2,000-mile flight over the Atlantic from Labrador and Nova Scotia to South America without a stop; while his relatives on the Pacific coast each year travel the 2,000 miles from Alaska to the Hawaiian Islands and back again. Not all birds, of course, migrate; for woodpeckers, nut-hatches, chickadees, grouse, and a host of others are permanent residents of Canada and the United States. But robins and bluebirds, herons and ducks, warblers, fly-catchers, thrushes, and hundreds of other species join the yearly migration from south to north and back again. (See Migration.)

The Mating of the Birds

During the winter the birds travel about in scattered groups, searching for food; and of course they do not nest, although a few of them sing fragments of their songs. The sexes are often in distinct flocks, and the reproductive organs are very small and nonfunctional. With the approach of spring the reproductive organs begin to enlarge and the birds begin to feel the instinct to move northward. The males are usually the first to start north, and arrive on the nesting grounds from a few days to a few weeks before the females. Once arrived, the males usually select the general locations where they wish to nest, and drive all rival males from these areas; at the same time they try to entice the females to remain and to mate with them.

Often a male returns to the same spot year after year, and frequently his former mate returns also and they remate for another year. This may occur until the death of one bird, when the surviving member

THE LAZY COWBIRD



A Cowbird, too lazy to hatch her own young, has laid two eggs in a Yellow Warbler's nest. Each time the Warbler covered over the unwelcome egg, and at last got a chance to lay her own eggs.

ordinarily finds a new mate and often returns to the same nesting site. Thus a pair of orioles have been known to nest in the same tree for 33 years, but undoubtedly they were not the same two birds. Although monogamy or a single mating for the year is the rule, a few birds, akin to our common poultry, such as the turkey, grouse, and pheasant, are regularly polygamous—that is, each male is mated to several females. Polygamy occasionally occurs among other birds, especially the wrens and blackbirds. Cowbirds do not have permanent mates, even for a single season, as they do not take care of their own young, but lay their eggs in other birds' nests. A bird of tropical America called the *anis* is regularly communistic—that is, the members of this species build a common nest in which several females lay their eggs, and all help to care for the young.

How the Birds Go Courting

Mating is never accomplished without a more or less elaborate courtship. It is during this period that birds are seen and heard to the best advantage, for the male birds try to make themselves as conspicuous as possible, both by their songs and by the display of their plumage. Of course all birds do not sing, and a few—such as the storks, the pelicans, and the frigate birds—seem to be voiceless in adult life. True song is confined to the higher families of birds, and reaches its best development among the thrushes.

The vocal organs of a bird are somewhat different from those of man, for instead of having vocal chords located in the *larynx* at the upper end of the *trachea* or windpipe, they have simple membranes, which vibrate, located at the lower end of the *trachea* in a structure called the *syrix*. The shape of this structure, and the number of muscles which control the tension of the membranes, vary with the different families of birds and produce the different songs.

Birds which are unable to sing usually have substitutes for song to announce their presence to the females. Thus the woodpeckers produce a loud tattoo by hammering with their bills upon a hollow limb or other resounding surface. The ruffed grouse produces a loud drumming sound by beating the air with its wings; and the woodcock produces a winnowing sound by mounting high in the air and zigzagging back to earth on set wings so that the wind whistles through the three outer wing feathers.

Even more interesting than the sounds produced by birds are the many curious displays of plumage and courtship antics. The display of the peacock, the turkey, and the domestic rooster are familiar to all; and many of the smaller birds can often be seen going through similar performances. Other birds, such as the pouter pigeons, the prairie chickens, and the European bustards, have peculiar air-sacs which they inflate during their courtship, giving them a very grotesque appearance. The European skylarks and our horned larks perform feats of flying during their courtships that are quite spectacular. After mounting to such a height that they are barely visible, and after hovering and singing at that dizzy height, they suddenly close their wings and drop like stones toward

the earth. One thinks they are about to dash themselves to pieces, when they gracefully spread their wings and alight, only to repeat the performance. Many of the albatrosses and cranes, and certain small birds as well, have elaborate series of hops, skips, and bows which might be likened to old-fashioned dances. Among the most elaborate courtship performances are those of the bower birds of Australia, which build little bowers of twigs or plant stems. These bowers are entirely distinct from their nests, and are usually decorated with bright berries, shells, or flowers, which are renewed as often as withered.

"Now for That House of Ours"

After mating, birds usually set about nest-building immediately. Although the male has already selected the nesting area, the female usually selects the exact nesting site and builds the nest, the male standing

guard near by or accompanying her in her search for nesting material, and permitting no other male to approach within his precincts. The character of the nest depends upon the species of bird and the family to which it belongs. It has undoubtedly had its origin in the requirements of the young—how long they must use it and the dangers to which they are exposed—together with the intelligence of the bird in meeting these requirements.

When birds evolved from their reptilian ancestors, they undoubtedly at first laid their eggs as do the turtles and lizards today, burying them in the sand or hiding them in holes in trees. But as they became warm-blooded creatures and the need for incubation arose to keep the eggs at a constant temperature, it

STATELY COURTING OF THE CRANES



Nothing can exceed in stately ceremony the dances of the Cranes. A traveler in Alaska thus describes one of these very formal social events: "The male suddenly wheeled his back towards the female and made a low bow, his head nearly touching the ground and ending by a quick leap into the air. Another pirouette brought him facing his charmer, whom he greeted with a still deeper bow, his wings meanwhile hanging loosely at his side. She replied by an answering bow and hop, and then each tried to outdo the other in a series of spasmodic hops and starts mixed with grave and ceremonious bows."

was necessary to lay them above ground, so that they could be brought into contact with the bird's body. At first the birds probably did not even scratch depressions to keep the eggs from rolling about, but laid them on the flat ground as do the night-hawks and whippoorwills today. The next stage was doubtless the scratching of depressions to keep the eggs from rolling, and we find this stage represented today by the nests of the killdeer and other plovers. An advance from this stage was the addition of a lining to the depression, such as is seen in the nests of the sandpipers. Such nests, however, give little protection against long spells of wet weather or against the numerous terrestrial enemies. It is easy to imagine that the birds that learned to raise their nests above ground, first on piles of vegetation and then into bushes and trees, were more successful in raising their young, especially if the young had to remain in the nest for some time.

It is not difficult to select from the nests built by birds today a series which shows the probable evolution of nest architecture, from the crudest to the most elaborate. Thus, the simplest platforms of sticks are built in the trees by the herons, while the crows and hawks build more substantial structures of sticks with deeper hollows to hold the eggs and usually with linings of softer materials. Continuing up the scale we find the coarse twigs discarded for finer and softer materials, until we come to such nests as those of the yellow warbler or goldfinch, which are made almost entirely of plant downs or other woolly substances. The

MR. FLICKER SHOWING OFF



Mr. and Mrs. Flicker have dug out their little cottage in a tree and Mrs. Flicker, sitting in the front door, is watching Mr. Flicker "show off" for her special benefit.

that they resemble knots instead of birds' nests. Robins, wood thrushes, and vireos weave in pieces of paper or cloth, to disguise their nests.

In selecting their nesting material, birds ordinarily take that which is nearest at hand, so long as it conforms to the type of the nest which that species builds. Thus field birds ordinarily use grasses and hairs, woodland birds use leaves and rootlets, and marsh birds use sedges and cattails. Birds like the oriole, therefore, which ordinarily use plant fibers, are quick to avail themselves of strings or yarn put out for them.

COURTSHIP OF HUMMING-BIRDS



When the Humming-bird is courting, the lady sits on a twig while her little knight flies over her backward and forward in a circle. Each time he passes her he swoops sharply coming as near her as possible.

It will be noticed, however, that they select only the light-colored pieces, which resemble the natural plant fibers.

Some kinds of birds are much more adaptable than others in suiting their nests and nesting places to changed conditions, and these are the ones that have been able to hold their own and even increase in numbers with the coming of civilization into this country. The bluebirds, wrens, chickadees, etc., that utilize neat

boxes instead of holes in trees; and the phoebe, that nests under bridges instead of on rock ledges; the barn and cliff swallows, that have deserted the cliffs for human habitations; and especially the omnipresent house sparrow, are examples of this power of adaptation.

How Long it Takes to Build a Nest

The time used to build a nest depends upon how much time the bird has before its first egg is ready to be laid. With ordinary birds the time required is about a week; but there have been many instances—when the first nest has been destroyed and the eggs are ready to be laid—of birds building their entire nests in a day. Occasionally birds that are permanent residents, such as the chickadees, or that arrive early in the spring, as do the phoebes, begin their nests long before the eggs are mature, and consume several weeks in building a structure that could be completed in a few days if necessary. At times certain birds simply mend old nests left the year before.

The eggs of birds are among the most beautiful creations of all nature. They vary in color from those

A GROUSE DRUMMING



This Grouse is sending a "wireless" message to the lady Grouse of the neighborhood by beating the air with his wings. This produces a peculiar whirring noise, easily recognized at a considerable distance.

highest type of nest is perhaps the beautifully woven structures of the oriole, hung at the tip end of a branch, though many of the simpler nests show curious specializations. The nest of the humming-bird and that of the wood pewee, for example, are covered on the outside with lichens and bits of bark, so

find. The majority of eggs, however, that are laid in nests, seem to be conspicuously marked rather than otherwise, for they are white or some light tint in ground color. In such nests there is no need for protectively colored eggs, because the bird ordinarily selects a site where the whole nest will be inconspicuous and thus hides her eggs at the same time. Thus it has come about that, with the evolution of nests, the need for protectively colored eggs has disappeared and the pigment has gradually degenerated, causing the many beautiful but conspicuous eggs that we find today. Indeed, it is the writer's belief that it is an advantage for nest-building birds to have conspicuous eggs; for if there is an enemy living in the vicinity that will sooner or later discover the

nest, it is to the bird's advantage to have it broken up as soon as possible so it can go elsewhere and try again before the season is too far advanced. If the nest remains safe through the first few days when the conspicuous eggs are left exposed, it stands a good chance of remaining safe through the entire period.

Number and Size of Eggs

It requires about 24 hours for an egg to be formed, so that ordinarily one egg is laid each day, at about the same time, until the normal number for the species is complete.

This number varies according to the dangers to which the eggs and young are exposed. Many sea birds that nest on inaccessible cliffs lay but a single egg, while the majority

Murre

that are as white as snow to those that are almost black, but the majority have a ground color of some delicate tint and are spotted or streaked with much darker colors. The yolk of the egg is formed entirely in the ovary of the mother bird, the albumen in the upper two-thirds of the oviduct, the shell in the lower third, and the color in the lowest end of the oviduct or else in the *cloaca* just before it passes out.

Many theories have been advanced to account for the coloration of eggs. It is almost certain that the color, as originally developed, was of some value to the eggs, probably in rendering them less conspicuous; for eggs like those of the woodpeckers and kingfishers, that have always been laid in dark holes where the color would not be seen, are pure white. Eggs such as those of the plovers and terns, on the other hand, that are laid in exposed places with no protecting nest, are colored like the soil or gravel and are very difficult to

Green Heron

Sharp-shinned Hawk

Barn-Swallow

Robin

Baltimore Oriole

Pied-billed Grebe

Fashions in nest building vary widely, as you can see here. That curious sea-bird the Murre solves the problem by not making a nest at all. Her single egg is laid on bare rocky cliffs, but its peculiar top shape insures its safety, for as soon as it starts to roll, it swings around in a circle. You can trace the development of nest architecture in the other pictures, from the crude bundle of twigs piled roughly together by the Green Heron, to the wonderfully elaborate weaving done by the Oriole.

contained in the Easy Reference Fact-Index at the end of this work

of game birds and water fowl, that have numerous enemies, lay from 10 to 20. The usual number for most birds is from three to five. If the last egg is removed from a nest as often as laid, the bird's ovary is sometimes stimulated to keep forming eggs in an endeavor to secure the normal number in the nest before the bird begins to incubate. Thus a flicker laid 74 eggs in 71 days, and the domestic fowl has been known to lay as many as 314 eggs in a year.

The size of eggs is fixed for each species, and varies from that of the humming-bird, which resembles a small bean, to that of the ostrich, which is between five and six inches in diameter. Occasionally, with very old domestic fowls or at the close of the egg-laying period, very small eggs are laid. Occasionally also two or even three eggs become enclosed in a single shell, forming the so-called "double-yolked eggs." These abnormalities occasionally occur also with wild birds. In general the size of the eggs varies with the size of the bird, but birds whose young are hatched blind and helpless lay much smaller eggs than those whose young are covered with down and able to run about when hatched. Thus the catbird and the spotted sandpiper are about the same size, but the egg of the sandpiper is about twice the size of that of the catbird.

How the Egg Becomes a Bird

With the laying of the last egg most birds begin to incubate, but a few like the owls begin to incubate with the laying of the first egg, causing the young to hatch on different days. The time required for eggs varies with the size of the egg, though for some reason a few small eggs require a longer time than some of the larger ones. Thus, while the eggs of the red-winged blackbird require but 12 days, and the eggs of the robin but 14, the eggs of the humming-bird require 15 days to hatch. Hen's eggs require 21 days, ducks' 27, geese's 35, etc. In addition to being maintained at a constant temperature by the heat of the bird's body, the eggs have to be regularly turned by the old bird, and occasionally moistened to keep the pores in the shell open and the membranes which line the shell moist so that the embryo can breathe.

With most birds the work of incubation is performed entirely by the female, the male either feeding her on the nest or standing guard by the nest while she flies off to feed. With dull-colored or sparrow-like species, in which the males are as dully colored as the females, the males share the duties of incubation; and the same is true of a few brightly colored birds, like the rose-breasted grosbeak.

There are two types of young birds—those that remain helpless in the nest for some time, and those which can run about as soon as hatched. The first

class are hatched blind and helpless, with only a scant covering of down. Their parents build well-formed nests in which they remain for varying lengths of time—from a week in such ground-nesting species as the vesper sparrow and horned lark, to a year in such birds of flight as the condor and the wandering albatross. The young of the second class, on the other hand, like those of the domestic fowl, are fully covered with down when hatched, have their eyes open almost immediately, and are able to follow their parents about in their search for food. They remain in the nest only a few hours, and their parents must, therefore, be birds that live on the ground or in the water.

Taking Care of the Young

All young of the helpless type are fed at first on partially digested food brought up from the crop of the parent bird. Doves, petrels, albatrosses, and a few other birds continue this method of feeding as long as the young require care; but the majority of

birds soon begin to bring fresh food to the young. This is usually carried in the bills or in the talons of the old birds; but herons, humming-birds, waxwings, and a few other birds continue to carry the food in their crops although it is not all digested.

The food of most young birds consists of insects at first, this being varied later by fruits or even seeds with some species. The insects are placed far down into the throats of the young birds, which normally stretch up their necks and open their mouths widely at the approach of their parents. Swallowing is entirely automatic, and unless food is placed beyond the base of the tongue, the muscles do not act and the food remains in the open mouth unswallowed. There is likewise a nervous

adjustment to prevent the young from being overfed, for after each has received sufficient food, the throat muscles refuse to work and the food remains unswallowed. After feeding, the parent bird always inspects the mouths of the young, which usually remain wide open, and if any food remains unswallowed, she removes it and gives it to one of the other young. As stated in the paragraphs on economic importance, the amount of food taken by young birds is surprising, for they require from one-half to their full weight of food each day in order to grow. To keep up this supply both parents work from early morning until nearly dark. In a few cases, like that of the humming-bird, the male bird never assists in the care of the young; but in most cases, the male is even more industrious than the female, and is likewise more courageous in the presence of danger.

After each feeding the nest is regularly inspected and all excrement is removed, so that the nest is

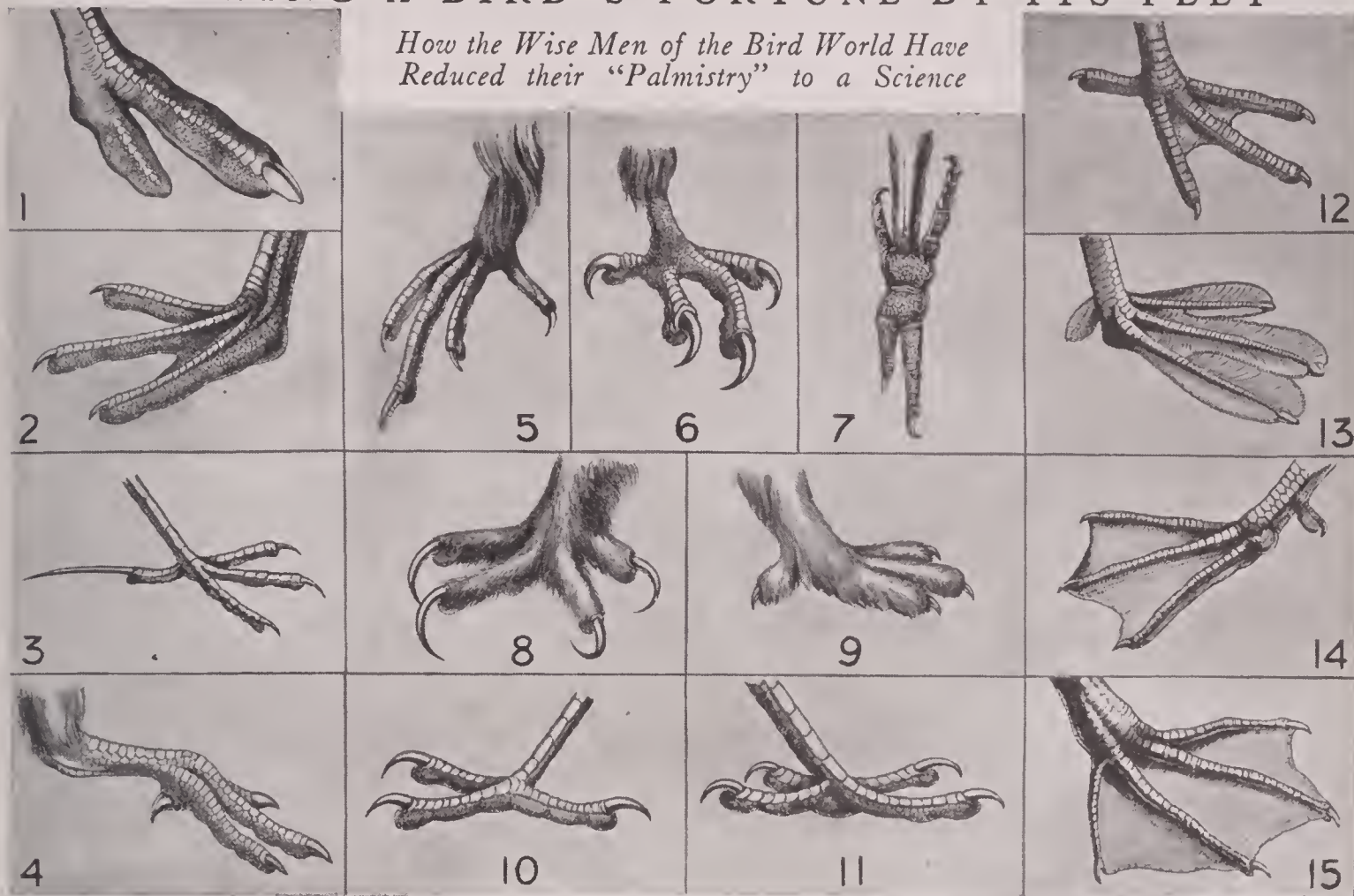
BABY BITTERNS



The babies in a Bittern's nest "come in sizes." The reason for this is that the parents begin hatching the eggs just as soon as Mrs. Bittern has laid the first.

TELLING A BIRD'S FORTUNE BY ITS FEET

*How the Wise Men of the Bird World Have
Reduced their "Palmistry" to a Science*



The study of feet among the birds may be called a scientific kind of "palmistry," for it tells a great deal about their lives, as the palmists pretend to do about the lives of human beings by looking at the lines in their hands. Here is what a bird "palmist" would say to an Ostrich on looking at that foot of his (1): "Your grandparents of some millions of years ago had five toes. The other three have disappeared because your family have put in so much time running. The third toe has grown very big, while the fourth toe, the only other one you have left, is dwindling. In the case of your grandchildren it will probably disappear altogether, just as happened with the horse."

Another thing the "palmist" would say to all these birds whose feet we see before us is: "Pardon me,—it doesn't sound like a nice thing to say to you—but your early ancestors were reptiles." He knows it by those scales, except in the case of the Tawny Owl (8) and the Ptarmigan (9), whose legs and toes are covered with feathers. All the other feet are scaled: Plover (2), Skylark (3), Apteryx (4), Night-jar (5), Sea Eagle (6), Toucan (7), Three-toed Woodpecker (10), Green Woodpecker (11), Stork (12), Grebe (13), Merganser (14), Pelican (15).

Feet 12 to 15 are clearly those of birds that frequent the water. In the Stork (12) the web reaches only to the first joint. In the Grebe (13) the web is attached to each toe, but these toe webs do not join. This makes it convenient for walking as well as swimming. Although Plovers (2) are water birds, they wade along shallow shores and so, instead of webbed feet for swimming, have long toes to distribute their weight as they walk over the sand and mud. A Woodpecker's feet (10 and 11) are arranged to give them a good grip on tree trunks. Toucans (7) like the Green Woodpecker have two toes projecting forward and two backward, while the Owl (8) can turn his third toe either backward or forward, as he chooses.

kept scrupulously clean. Flesh-eating and fish-eating birds are exceptions to this rule, and their nests often become quite foul.

Clothes of the Bird and How They are Changed

A few young birds of the helpless type, such as flickers and pelicans for example, are absolutely naked when hatched, but the majority have a scant covering of down on the back and on the top of the head. Feather growth starts immediately, and within a week or 10 days the majority of small birds are fully covered with feathers, and within 10 days or two weeks are able to fly. The largest birds of flight, however,—the condor and the albatross—as already indicated, do not learn to fly for nearly a year.

The first covering of all young birds is called the *natal plumage*. The covering of the fledgling is called the *juvenal plumage*, and it is worn only a short time after leaving the nest. It is then replaced by the *first winter plumage*. These feathers are worn through-

out the winter; but, in the case of most birds, towards spring they are replaced by the first breeding or *nuptial plumage*. This is worn throughout the breeding season, being replaced again in the fall by the winter plumage.

The change from one plumage to another is called a *molt*, and takes place very gradually. When a bird is in good health only a few feathers are shed at a time, and these are replaced before others are shed, the whole process requiring from one to two months. The molt always begins at a definite place on the bird's body, and the feathers are lost in a regular order. Thus, in the wing, the first feather to be lost is always the innermost primary feather, and when the new feather replacing it is about half grown, the next one is shed; and so on, so that the bird is never deprived of the power of flight. In a few swimming and diving birds, that are not entirely dependent upon their wings for escape, all of the flight quills are shed at one

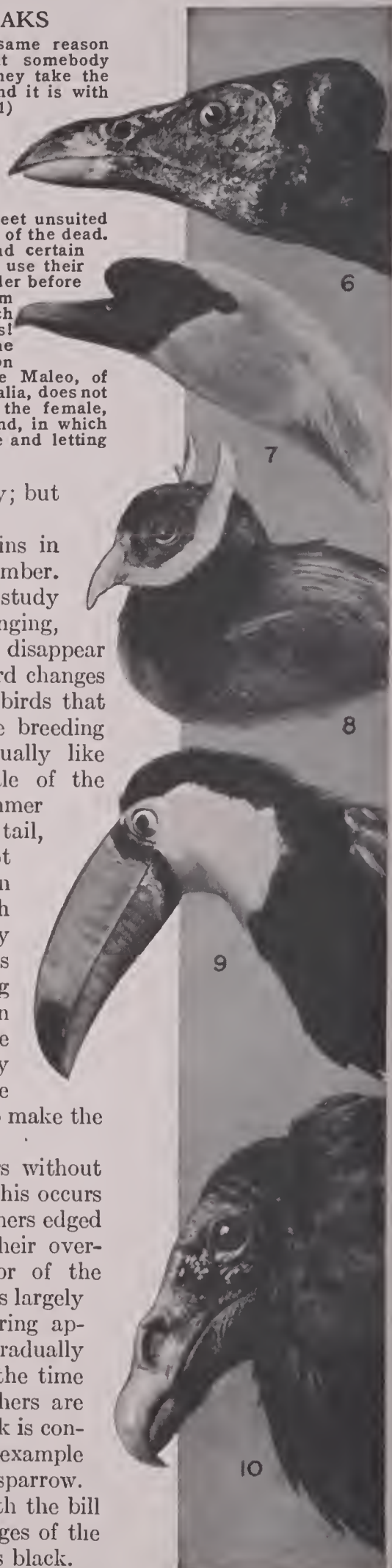
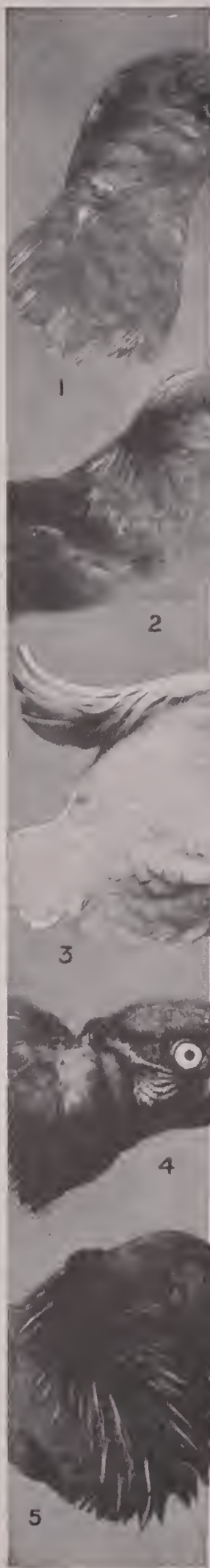
WHAT WE CAN LEARN FROM BEAKS

Birds may be said to "present their bills" for the same reason that people present bills—because they feel that somebody owes them something! In the case of the birds, they take the position that Mother Nature owes them a living, and it is with their bills that they help to collect it. The Pigeon (1) and the Eared Pheasant (8), have small weak beaks suitable for picking up seeds and the like. The birds of prey such as the Hawk (2) have strong curved beaks for tearing flesh. You can see that those weird creatures, the King Vulture (4), the California Vulture (5) and the Turkey Buzzard (10) are related to the hawks, but having feet unsuited to hold living prey, they feed on the decaying flesh of the dead. The Parrot (3) is related to the birds of prey, and certain parrots occasionally eat flesh; but ordinary parrots use their beaks for grinding up nuts and seeds almost to a powder before swallowing them. Even the wise men of Bird-dom don't know just why the Toucans (9) should have such immense beaks. Perhaps it is just a fancy of theirs! The same is true of the fleshy knob on the beak of the Mute Swan (7) and the big black bump on the back of the head of the Maleo (6). The Maleo, of the Celebes Islands, like the Malee of Australia, does not sit on its eggs. Instead of building a nest the female, assisted by the male, digs a hole in the sand, in which it deposits its large eggs, filling up the hole and letting the sun do the rest. (See Eggs.)

time, and for a time the birds are unable to fly; but this is an exceptional form of molting.

The summer molting season usually begins in August and continues through a part of September. This is the most difficult season of the year to study birds, because during the molt they stop singing, seek seclusion, and many species seem to disappear altogether. During this molt every bird changes every feather on its body, and most birds that have been brightly colored during the breeding season now assume sober colors, usually like those of the female. Thus the male of the scarlet tanager, which during the summer is bright red with black wings and tail, now becomes green like the female, except that his wings and tail still remain darker than hers. During the spring molt, only such feathers are replaced by birds as are necessary to bring them into breeding colors. Thus the scarlet tanager does not shed its wing and tail feathers, for they are the same in both plumages. Birds which have the same color in winter as in summer usually do not have a spring molt, since the feathers are not yet sufficiently worn to make the physical strain of molting worth while.

Some birds appear to change their colors without molting by a process called *feather wear*. This occurs only with such birds as have their new feathers edged with brown or gray; for these edges, by their overlapping, conceal the underlying main color of the feather. Thus the rusty blackbird appears largely brown in its winter plumage, but as spring approaches and the brown edges wear off, it gradually becomes blacker and blacker until, by the time the breeding season has arrived, its feathers are shiny black. Often some prominent mark is concealed in this way during the winter, as for example the black throat patch of the male house-sparrow. This appears as a narrow black spot beneath the bill all winter, but by May or June the gray edges of the feathers have worn off so the entire throat is black.



It is impossible to imagine a color that could not be matched by the plumage of some bird, but in spite of this fact there are only four pigments or color substances found in the feathers of birds—black, brown, red, and yellow. In a small group of African birds called turacos, a green pigment also is present; but all other greens, and all blues and metallic colors, are due to the *structure* of the feathers rather than to pigments. It is usually the superficial layers of cells that are prismatic in shape and cause the refraction

birds appear much redder than the normal coloration, irrespective of age or sex. This is well shown in the red and gray phases of the common screech owl and in certain other dull-colored species.

When there is a difference in the coloration of the male and the female bird, it is usually the male that is brighter. Among North American birds, the *phalaropes* (a group similar to the sandpipers) are exceptions to this rule, the females being brighter than the males. It is interesting to note in this case

HOW BIRDS PRACTICE CAMOUFLAGE



You might wonder why those two Snow Buntings aren't all white, but don't you see how those dark patches of color would help them to blend in with a background of snow-covered bushes, so that a Hawk, for example, away up in the sky, couldn't make them out at all? The Ptarmigan, just below, is all white because he sits directly on the snow. The Bittern, with his head straight up among the tall grass of a marsh, is easily confused with his surroundings; and the same is true of the blending of the Woodcock's markings and the dead leaves. The Screech Owl sitting in the daytime on a dead tree, looks to be a part of it, while the Whippoorwill crouching below seems a part of the mottled soil.

that gives the color to the feather. To see the color at its best, therefore, the observer has to be in good light with the sun at his back. It is for this reason that a bluebird appears black when it is between one and the sun, and it is also for this reason that it is often difficult to identify the birds one sees under unfavorable light conditions.

Occasionally birds are seen whose feathers are deficient in pigment. There may be only a few white feathers in the plumage, or the entire bird may be spotted, or it may be entirely white. In the latter case it is said to be a pure *albino*. Albinism may occur in any species. In a few species the red pigment occasionally becomes overdeveloped and the

that the males incubate the eggs and care for the young, while the females go off by themselves; for it is believed that the dull coloration of most females is due to the need for being inconspicuous on the nest. Added strength is given to this belief by the fact that in the families of birds that always nest in holes, notably the woodpeckers and kingfishers, the females are just as brilliant as the males. Being out of sight when incubating they do not need to be protectively colored.

When the males and females are colored differently in the breeding season, the male in its winter plumage usually takes on a coat very similar to the female. It is for this reason that so few brilliantly colored

birds are seen during the fall migration and during the winters spent in the south.

When the male and female differ in color, the young birds in juvenal plumage usually resemble the female. If both sexes are alike, the young are similar, unless the adults differ in coloration materially from the other members of the family. In such cases the young often show the characteristics of the family. Thus young robins and bluebirds have the spotted breasts characteristic of the thrush family, and young field and chipping sparrows have the streaked breasts of the sparrow family, although the adults in both cases have unmarked underparts. The juvenal plumage is usually lost after the first winter, in time for the first breeding season; but a few birds like the redstart and orchard oriole do not change until after the breeding season. It is for this reason that one often sees individuals that seem to be females of these species singing, though they are in reality young males.

Bird "Camouflage"

When one begins the study of birds he very soon realizes that some birds are much more easily seen than others. He soon learns that certain birds, such as the tanagers and warblers, are quite conspicuously marked; while others, for example the sparrows and shore-birds, are protectively colored. The conspicuously marked birds are ordinarily shy birds and do not permit of very close approach, while those that are protectively colored will often allow you almost to step on them before taking wing.

This form of "camouflage" among birds is an interesting example of the manner in which Nature safeguards animals from their foes (see Protective Coloration).

There are today between 13,000 and 14,000 species of birds found in the world, of which 766 are found in North America north of Mexico. Before anyone can handle conveniently any such large group of

objects or facts, it is necessary that they be systematically arranged, and this arrangement is called classification. Just as the books in a library are classified and placed on shelves according to their contents and

relationships, so in the classification of birds—and indeed of all animals—the endeavor is made to put similar animals together in groups, and similar groups together in larger groups, etc. And just as in the library the books are not arranged according to their size or the color of their covers, so with birds—their classification is based upon their *structure* rather than upon external similarity.

Beginning with the largest groups, we find that the *animal kingdom* is divided into a number of *phyla* (from the Greek word meaning "tribe") or branches, of which the birds, together with the mammals, reptiles, amphibians, and fishes belong to the highest group, called *Chordata* or back-boned animals, as opposed to the insects, mollusks, crustaceans, etc. Each phylum is divided into a number of *classes*, the birds belonging to the class *Aves*. Each class in turn is divided into a number of *orders*, and, according to the classification still in use in the United States, there are 17 of these orders represented in North America, as given in the accompanying table.

Some of these families are represented by only one or two species in North America, while others contain 40 or 50. In the larger families certain species are always more like each other than like the other members of the family, and so it has been found convenient to divide each family into *genera* (singular, *genus*). Thus in the thrush family we have a genus to include the various bluebirds, another to include the various robins, another to include the various thrushes, etc.

A species has been defined as a group of individuals that resemble each other as the offspring of a single parent, and would naturally be the smallest division necessary for all ordinary usage. However, in studies of the distribution of birds, it has been discovered that species

of birds that have a wide range over the continent usually vary in different parts of their ranges, and, in order to show to which local race an individual bird belongs, it has been necessary to divide the species into sub-species or varieties.

ORDERS OF AMERICAN BIRDS

- Order I. *Pygopodes*, or diving birds, including the grebes, loons, and auks.
- Order II. *Longipennes*, or long-winged sea birds, including the gulls, terns, jaegers, and skimmers.
- Order III. *Tubinares*, or tube-nosed sea birds, including the albatrosses and petrels.
- Order IV. *Steganopodes*, or yoke-tocd water birds, including the gannets, pelicans, cormorants, tropic birds and snake birds.
- Order V. *Anseres*, or waterfowl, including the ducks, geese, and swans.
- Order VI. *Odontoglossae*, or flamingoes, including only the flamingoes.
- Order VII. *Herodiones*, or wading birds, including the herons, storks, ibises, and spoonbills.
- Order VIII. *Paludicolae*, or marsh-birds, including the cranes, rails, coots, and gallinules.
- Order IX. *Limicolae*, or shore-birds, including the phalaropes, snipes, sandpipers, and plovers.
- Order X. *Gallinae*, or fowl-like birds, including the turkeys, grouse, bob-whites, and pheasants.
- Order XI. *Columbae*, or pigeons, including only the pigeons and doves.
- Order XII. *Raptores*, or birds of prey, including the hawks, owls, and vultures.
- Order XIII. *Psittaci*, or parrots, including only the parrots and paroquets.
- Order XIV. *Coccyges*, or cuckoos and kingfishers, including only these birds.
- Order XV. *Pici*, or woodpeckers, including only the woodpeckers.
- Order XVI. *Machrochires*, or long-winged birds, including the night-hawks, whippoorwills, swifts, and humming-birds.
- Order XVII. *Passeres*, or perching birds, including all of the common birds not already enumerated, by far the largest number of any of the orders.

Each of these orders is divided into a number of families. Thus the order *Passeres*, or perching birds, is represented by 20 different families in North America, as given in the following table: *Tyrannidae*, or flycatchers; *Alaudidae*, or larks; *Corvidae*, or crows and jays; *Sturnidae*, or starlings; *Icteridae*, or blackbirds, orioles, bobolinks, and meadow-larks; *Fringillidae*, or sparrows, finches, grosbeaks, and crossbills; *Tangaridae*, or tanagers; *Hirundinidae*, or swallows; *Bombycillidae*, or waxwings; *Laniidae*, or shrikes; *Vireonidae*, or vireos; *Mniotiltidae*, or wood warblers; *Motacillidae*, or wagtails and pipits; *Mimidae*, or thrashers, mocking birds, and catbirds; *Troglodytidae*, or wrens; *Certhiidae*, or creepers; *Sittidae*, or nuthatches; *Paridae*, or chickadees and titmice; *Sylviidae*, or kinglets and gnatcatchers; *Turdidae*, or thrushes.

LEADING FAMILIES *Among Our* BIRD PEOPLE



VERY bird in the world belongs to a tribe, and each bird tribe or order has some peculiar structure of foot or beak or wing that distinguishes it from all others. Once you know these marks, birddom becomes a book of never-ending interest. These pictures are selected and arranged to bring out all the more important orders of our American birds with their distinguishing marks. The articles appearing on other pages under each bird's name should also be consulted.



THIS is the common Tern or "Sea-Swallow" (*Sterna hirundo*) that tells the fisherman where to cast his nets. Feeding on the small fry that are driven to the surface by their larger foes, the Terns gather in screaming thousands over passing schools of fish. In snatching their prey from the waves they rarely wet more than their heads and necks. The Terns belong to the order of long-winged swimmers (*Longipennes*), which comprises also the Gulls, the Jaegers, and the Skimmers.



LIKE all the long-winged swimmers (*Longipennes*), the Gulls are strong-beaked noisy creatures and are usually seen flying near the shores of sea or lake. The Herring Gull (*Larus argentatus*), shown here with its darker colored young, is one of the commonest of the Gull family. Besides fish, it also feeds on carrion or on any scraps of food thrown overboard by coastwise ships. It is the most familiar bird in large harbors, where it boldly flashes its brilliant white breast in the wake of churning vessels, or rides the choppy waves like a cork. It is a skilful opener of clams, dropping them again and again from high in the air to the hard beach, until the shells crack.

BEGINNING with water birds, we see first the Pied-billed Grebe or "Hell-diver" (*Podilymbus podiceps*), a far better swimmer than any duck. Like a submarine it can float with its whole body showing, or sink until only its sharp eyes are visible. The Grebes belong to the order of diving birds (*Pygopodes*), which includes the Loon, the grotesque Puffin, the strange extinct Great Auk, and many others. All have stumpy legs and are very awkward on land.



THE solemn-looking bird below is the Brown Pelican (*Pelecanus occidentalis*), bulky, powerful of wing, and a great fisherman. It flies low over the water, turning its head from side to side in the most comical manner, and plunging in like a stone when it sights a flash of silver near the surface. Its appetite is enormous, and when it can swallow no more, it fills the great pouch beneath its beak with fish to be eaten later at leisure or to be fed to its young. Often the Laughing Gull, a relative of the bird in the next corner, watches until the Pelican is struggling with a new-caught fish, then alights on its great beak and snatches the prey away. Pelicans frequently travel across country in regular wedge-shaped lines, beating their wings in perfect unison. The White Pelican is a more showy bird than the brown, and is commoner in northern regions. Pelicans are members of the order of yoke-toed swimmers (*Steganopodes*), which have all four toes joined by webs. The Gannets, the Darters or "Water Turkeys," the Cormorants, and the Frigate-birds or "Man-o'-War" birds, also belong to this order.





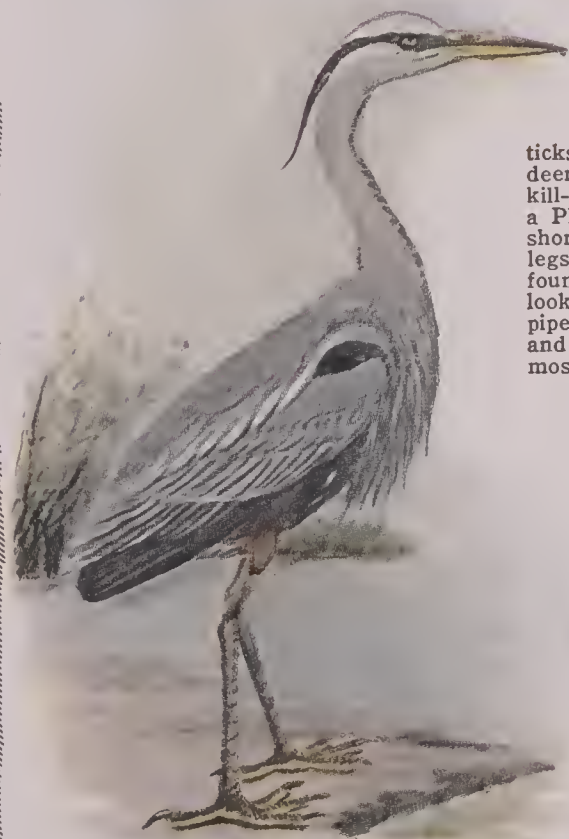
ALL sportsmen know the Mallard Duck (*Anas platyrhynchos*), for it is the chief water-fowl of most wild duck preserves. The bright green head and vivid markings of the male make him a conspicuous figure on our northern water courses, but the female Mallard wears dusky brown and tawny plumage. Like all ducks, the Mallard has a round bill with saw-tooth edges, webbed feet, and an awkward waddling gait—the latter due to the fact that ducks' feet, which are designed especially for swimming, are placed far back on the body.



OCCASIONALLY this gorgeous bird is seen stalking about in Florida. It is the Scarlet Flamingo (*Phoenicopterus ruber*), and it is the only one of the Flamingoes (*Odontoglossae*) found in this country. Its clumsy-looking bill is really a contrivance for straining its food. The lower part is fitted with holes, so that when the bird reaches down and takes a billful of food—frogs and shellfish—from the mud, the dirt and water run out leaving its prey behind. For a nest the flamingo scrapes up a tall mound of mud out of the marsh, with a hole in the top in which to lay its one or two white eggs.



HERE is an active little bird (*Oxyechus vociferus*) that helps us by eating harmful insects, such as mosquitoes, fever ticks, and weevils. It is called the Killdeer because it keeps calling "Kill-dee, kill-dee," in a loud shrill key. It is a Plover and belongs to the order of shore birds (*Limicolae*) whose slender legs are adapted to wading. It is often found running along plowed fields looking for worms. Snipes, Sandpipers, and Curlews, Surf-birds, Stilts, and Avocets are all members of this most interesting group of birds.

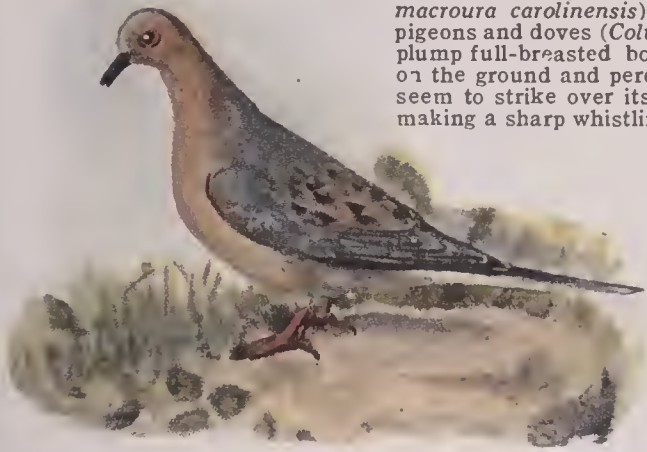


THIS dignified-looking bird is the Great Blue Heron (*Ardea herodias herodias*), and he is an expert fisherman. He stands motionless in the shallow water until he spies a frog or fish coming along, then like a flash his long neck straightens out and the luckless fish is caught in his swordlike bill. His long legs are well adapted to wading among the reeds along shore. Like most fishermen the Blue Heron usually prefers to be alone, but at nesting time he and his mate join a colony of Herons that may include as many as 150 nests. Other long-legged wading birds (*Herodiones*) are the Storks, Ibises, and Spoonbills.



"BOB-WHITE'S" cheery note is one of the most familiar of bird-calls, for almost every farm has its covey of Quail (*Colinus virginianus*). These birds live in flocks and often sleep side by side in a circle on the ground. "Bob-White" is one of the fowl-like ground-dwelling birds (*Gallinae*), and he is well fitted for such a life. He can build a nest on the ground so cleverly that it cannot be found, while his brown plumage with its black and white markings enables him to flatten out in the dry grass or stubble and become almost invisible.

THE peculiar quality of its call, which suggests both deep devotion and great sadness, has given to this bird (*Zenaidura macroura carolinensis*) the name Mourning Dove. Like all pigeons and doves (*Columbae*), it has a small head, short neck, plump full-breasted body, and feet equally suited to walking on the ground and perching in trees. When it flies its wings seem to strike over its back, like those of our tame pigeons, making a sharp whistling sound at the same time.



THE above group of birds are called the *Raptores*, or birds of prey, because they live upon other birds and animals. They all have hooked bills, and toes arranged for tightly grasping their victims. The bird with widespread wings is the "Turkey Buzzard" (*Cathartes aura septentrionalis*), and is really a species of vulture. It sees great distances and soars high in the air looking for food. Below is our national bird, the Bald Eagle (*Haliaeetus leucocephalus*), which loves the heights and nests in the top of tall trees; as it lives chiefly on fish, its home is never far from the water. A country cousin of the Eagle is the Sparrow Hawk (*Falco sparverius*), which is shown opposite to the Turkey Buzzard. Unlike other *Raptores*, the Owls (which occupy the rest of the page) work at night. We have below the Barn Owl (*Aluco pratincola*) with its heart-shaped face and big ruff; and the round-faced Screech Owl (*Otus asio*) whose awesome wail is familiar to every country child.



THE Humming-bird needs strong wings, for it keeps flying while it sips the honey from flowers, its rapidly vibrating wings being almost invisible. Here are shown the male and female Ruby-throated Humming-birds (*Archilochus colubris*) gathering dandelion down to line a nest. The order to which Humming-birds belong is called *Macrochires*,

because of the length of the terminal portion of their wings. Another member of the order (upper left) is the Night-hawk (*Chordeiles virginianus*), which flies about at twilight catching insects and uttering loud cries. Like its relative, the Whippoorwill, it has a surprisingly large mouth, but is in no way a hawk. More familiar members of this order are the Chimney Swifts (upper right) (*Chaetura pelagica*)—often confused with the Swallows—that circle around the chimneys at bed time. Formerly these birds nested in hollow trees, but now they make their homes in tall chimneys.



THE Woodpecker's *rat-a-tat-tat* is the forest rising bell. He clutches the side of a tree, braces himself with his stiff tail, then pounds with his head like a riveter, boring holes so that he can run his long tongue into the bark for grubs. The Flicker or Yellow-Hammer (*Colaptes auratus*) is the friendliest of the woodpecker tribe (*Pici*). People also call it a "high-holder" because it often nests in the top of tall tree-stubs. The small Downy Woodpecker (*Dryobates pubescens*), shown to the right, may be seen busily hopping up and down the trees in many of our northern villages and groves. To the left is the Yellow-bellied Sapsucker (*Sphyrapicus varius*), which drills numerous holes in the bark of trees for the sap which he thus gets. His tongue is not barbed like those of the other woodpeckers, but has a little brush on the end to wipe up the sap.



UNLIKE the European Cuckoo, the Yellow-billed Cuckoo of America (*Coccyzus americanus*) builds a nest of its own instead of laying its eggs in some other bird's nest. It is a mysterious bird and goes slipping through the trees like a ghost. The call of the American Cuckoo is not at all like that of its European cousin, as represented by the musical note of the cuckoo clocks, but is rather a series of hoarse clucks. To the same order (*Coccyges*) belongs the handsome crested Kingfisher, shown in the upper left-hand corner of this page. His skill as a fisherman commands admiration, for he can see a fish under water from a height of 50 feet and dive down and catch it. Usually he catches minnows and other small fish which he can swallow whole, the fish going down head foremost.

Most of our feathered friends belong to the order of perchers (*Passeres*), the largest of all our bird groups. The distinguishing characteristic of the order as a whole is that the four toes are so arranged as to give unusual strength for grasping branches. The last four birds shown on this page and those on the three following pages all belong to this order.

THE Kingbird (*Tyrannus tyrannus*) is a fearless member of the above order, attacking hawks and crows with his bill, and even clinging to their backs, screaming loudly all the while. He is an expert flycatcher and likes to perch at vantage points watching for insects; when he sees one, he darts for it, returning afterward to his post.

THE Red-winged Blackbird, who flaunts his gay plumage in the center of our page, belongs to the family of *Icteridae*. It nests in colonies in the rushes. While his more soberly clad mate sits on her nest of woven grasses, he swings on the cattails and reeds of our marshes and sings *o-ka-lee, o-ka-lee* at the top of his voice.

THE Starling is a naturalized citizen, for the first of this family were brought to New York in 1890. Like the common European Starling (*Sturnidus vulgaris*) the American variety has long wings, a short square tail, and metallic glints in its plumage. It looks like a blackbird with a yellow bill. Its habits are similar to those of the English Sparrow, and already it is contesting the latter's supremacy in many of our eastern cities.

THE Western States are the home of the Bullock Orioles (*Icterus bullocki*). Although they are especially fond of nesting in fruit trees near a house, they can usually be found in the poplars along the streams and irrigation ditches. The Oriole's nest is a hanging one of horse-hair and fibers, so cleverly woven that it lasts from year to year, and even springs back into shape when pressed together.



SOMEONE has aptly called the Bobolink (*Dolichonyx oryzivorus*)—another of the *Icteridae*—the “Dr. Jekyll and Mr. Hyde” of birddom. In the spring he comes north in dashing black and white costume, ready to captivate all with his rollicking song as he flits about the meadows. But in the fall he dons a dull mottled garb and flies south to the rice fields where he does great damage to the ripening grain.



QUITE different is the Meadow-lark (*Sturnella magna*), a handsome cheery bird of the best of habits which destroys many harmful insects. It lives in the open fields and builds its nest on the ground under a tuft of grass. It is quickly recognized in flight by the outer white tail feathers that flash in the air. On the ground the Meadow-lark neither hops nor runs; it is one of the few birds that walk. Its song is one of the sweetest of the bird-calls.



EVERYONE knows that street gamin, the English Sparrow (*Passer domesticus*). Although he was not brought to this country until 1850, he has succeeded in taking almost complete possession of our cities, driving out our native songbirds. He belongs to the largest of the bird families—the *Fringillidae* or Finches, all of which have strong cone-shaped bills, well suited to eating seeds.



MUCH more lovable is the familiar Song Sparrow (*Melospiza melodia*), a little roadside minstrel that perches on low bushes and fence posts, throws back his head, and pours forth the sweetest song. He has adapted himself to local conditions so well that his habits and appearance vary in different parts of the country, but he can always be told from other sparrows by the wedge-shaped streak of black and large spot on his breast.



ANOTHER member of the Finch family is the Rose-breasted Grosbeak (*Zamelodia ludoviciana*), with his handsome black, white, and rose plumage, one of the loveliest of our summer visitors. He is retiring in habits and stays near his nest in the woods. He is a valuable aid to the farmer, in destroying quantities of potato bugs.



THE Black-headed Grosbeak (*Zamelodia melanocephala*) is the western cousin of the Rose-breasted Grosbeak. By eating scale insects he helps to save many an orchard crop on the Pacific coast. His happy song can be heard all day long.



THE yellow plumage and sweet song of the Goldfinch (*Astragalinus tristis*) have won for him the name “wild canary.” During the early summer he and his mate frolic over the fields and berry patches, and then gather grass and thistle-down for their home in some low bush. In autumn they gather in flocks to travel south for the winter.

HERE are some more representative families of the order *Passeres*. The Loggerhead Shrike or "Butcher-bird" (*Lanius ludovicianus*), the first of the series, likes to perch on the top of a small tree, telegraph pole, or fence to watch for grasshoppers, snakes, and mice. When he has caught his food he impales it on a thorn to hold it while he is tearing it to pieces with his hooked bill.

THE Swallows all have short flat triangular bills, long strong wings, and tails that are either notched or forked, like the Barn Swallow (*Hirundo erythogastra*), which is here shown. Once the Barn Swallows nested in caves, but long ago they grew tame and learned to live about barns and sheds, thus getting the name "Barn Swallow." They spend most of their time on the wing, catching insects and eating them as they fly.

INSECTS on the foliage of trees and shrubs furnish the food for this active little Red-eyed Vireo (*Vireosylva olivacea*), shown just underneath the Barn Swallow. He is a persistent singer and keeps repeating his song from morning until night. Like others of the vireo family—whose name is Latin for "I am green"—he builds a beautiful hanging nest of finely woven grasses and fibers in the fork of a tree.

THE trills and melodies of the Mocking-bird (*Mimus polyglottos*) make the sweetest of serenades. Nothing is too difficult for this southern songster to attempt; a dog's bark, bird-calls, and even the sounds of instruments are included in his repertoire, and he also has a love song all his own. He is the most accomplished singer of the mimicking birds (*Mimidae*), among whom are included also the Catbird and Brown Thrasher.

SCATTERED flocks of Pipits (*Anthus rubescens*) loiter in our pastures and plowed fields on their way south from their summer haunts in Canada. They like the open country and prefer wet fields and bogs. They are ground birds and run about looking for worms and insects. When frightened they fly into the air with great leaps, calling *pipit, pipit*.

THIS mite of a bird is the fussy little House Wren (*Troglodytes aedon*). Jenny Wren knows that she is an excellent housewife and flirts her tail with becoming pride. She will build her nest in any old can or basket that happens to be convenient, if it has an entrance small enough to keep other birds out. Her long curved bill, short wings, and pert tail are characteristic of the wren family, whose name *Troglodytidae* means "cave dwellers."

THE Brown Creeper (*Certhia familiaris americana*)—shown in the lower right-hand corner—is a quiet sort of a bird; and though he and his cousins the Nuthatches are classed as "song-birds" (*Oscines*), because they have vocal organs, they are not real singers. They live on little insects which they find as they scramble incessantly over the trunks and branches of trees.





THE White-breasted Nuthatch (*Sitta carolinensis*), shown on the left, is supposed to get its name from its habit of wedging beech-nuts and other nuts in crevices of the bark and breaking them with its beak. It clings to the bark entirely with its claws, for its tail is too short and round to be used as a brace like the Woodpecker's.

A WINTER snow storm is an opportunity for a romp for the cheery little Chickadee (to the right). Like the Nuthatch, the Chickadee (*Parus atricapillus*) does not mind in the least being upside down as he goes poking over trees for insects. He dresses in plain dull colors, as do the other members of the Titmouse family.



THE Scarlet Tanager (*Piranga erythromelas*) is a gay fellow who flashes through our woods in summer with such brilliance as to merit the name "Fire-bird" sometimes given him. His mate, however, is a modest creature in olive green, but resembling her husband in the blackness of her wings. The song resembles that of the robin. The Tanagers are an American family of *Passeres*, and are found from Canada to Argentina.



ROBIN Redbreast (*Planesticus migratorius*) needs no introduction, for he is the most familiar of our Thrushes. In the spring the children watch for him because he tells them that the winter is over. He is such an affectionate fellow and seems to enjoy human society so much that we gladly forgive him for the cherries and other small fruits that he eats.



ITS fondness for myrtle shrubs gives the bird shown beneath the Robin the name Myrtle Warbler (*Dendroica coronata*). It lives in the woods and hedges, where it hunts among the leaves for insects which are its food. The bright yellow patch above its tail distinguishes it from the other Wood Warblers. They all have beautiful plumage in which yellow is the characteristic color, but they are especially known for their sweet caroling songs.



THE Horned Lark (*Otocoris alpestris*)—shown in the lower left-hand corner—is the only member of the true Lark family (*Alaudidae*) which lives in North America. He loves the plains and deserts and his nest is built on the ground in pastures, often before the snow disappears. Like the rest of his family he is an excellent musician, and his jubilant song tells us what it means to be as "happy as a lark."



THE tiny sprite in the opposite corner is the Ruby-crowned Kinglet (*Regulus calendula*), who is just as merry a winter bird as his playmate the Chickadee. He is very proud of his bright crest which he can uncover when he wants to show it off. Indeed the kinglets (*Sylviidae*) receive their name from this patch of bright color on the crown of their heads which brightens up their otherwise dull plumage of olive, brown, and black. They eat the seeds of weeds and poison ivy, as well as scale insects and other harmful pests.





BIRDS' SONGS AND HOUSES



*How pleasant the life of a bird must be,
Flitting about on each leafy tree!
"Come up! come up!" they seem to say,
Where the topmost twigs in the hedges stray.
"Come up! come up! for the world is fair
Where the merry leaves dance in the summer air."
And the birds below give back the cry,
"We come! we come! to the branches high."
How pleasant the life of a bird must be,
Living in love in a leafy tree!
And away through the air what joy to go,
And to look on the green, bright earth below!*

—M. Howitt, 'Birds in Summer'.

WISE Doctor lives in a village in the Middle West, on the banks of a beautiful river, in the midst of a broad bird-haunted lawn and garden. He has the finest flowers, fruits, and vegetables in the town, although he never seems to take any more pains with them than his neighbors. People say he is lucky and has the "knack" of growing things, but the Doctor only smiles and says:

"I have all of my little feathered friends to help me." Few people understand just what he means by this.

As the years have gone by and the song birds—which are insect eaters—have become fewer, the Doctor's grounds are almost the only place in town where many of them nest. This is because he always has numbers of houses for them to build their nests in and rear their young, and also little shelves or "invitations to nest," as the Doctor calls them. These latter are placed under the eaves, in the tree-tops, and five or six feet high in the shrubbery, for birds that would not build in a house—such as the Robins, Orioles, Catbirds, Scarlet Tanagers, Thrushes, Cardinals, and Grosbeaks. Shelters are also put out where the birds can find refuge in advance of and during early and late storms, and they are always kept stocked with a special balanced grain mixture, suet and suet cake, so the birds know they can always find food and shelter in the Doctor's grounds. While

the birds do not always patronize these shelters in the summer-time, they will fly for miles in times of stress to the Doctor's feeding stations, knowing that food and shelter will always be there for them. Bird baths also are kept full of fresh cool water in the summer-time and warm water in the winter-time; and building material is put out in the crotches of the trees and in the shrubbery. This consists of string or twine cut into six-inch lengths, or perhaps an old gunny or potato sack, cut in six-inch squares and tacked up in out-of-the-way places where it will not be unsightly, and yet where the birds' bright eyes can find it and ravel it out. A pan of mud is also placed in or behind the shrubbery, so that birds such as the Robin, Catbird, Brown Thrasher and Redbird, which cement their nests together, can dip the string or jute into the mud and carry it to their nests and cement it into place. Having attracted the birds to his garden and grounds, the Doctor keeps a sharp lookout for cats or other enemies which might come into his sanctuary to frighten or kill his pets.

Everything that the birds want the Doctor gives them. He seems to know their tiny minds better even than they do themselves. He listens to their songs and twitterings and can tell when something is making them unhappy. If his little guests quarrel among themselves—and even the best-behaved birds will sometimes quarrel—he has a way of settling the difficulty. Perhaps a stranger has arrived in the colony, and has picked out some other bird's pet roosting place, or perhaps the fight has started at dinner time around a feed-box. In any case, the Doctor usually finds a way to patch up the trouble, for he knows the birds "by heart."

For any subject not found in its alphabetical place see Index

And in return for all these things, the birds act as policemen for the Doctor's garden. Let so much as a single caterpillar poke his nose through the hedge, and he is a "goner." And music! Well, the Doctor has music the whole day long.

Sunrise Concert on the Porch

The dearest treat the Doctor can give to the boys and girls of his acquaintance is to invite a few of them at a time to a sunrise concert on his vine-covered side porch. There, as still as mice, they listen to the bird songs, look through the Doctor's big field-glass, and watch the happy singers at work or play. Now and then the quietest child of all is allowed to peep into what the Doctor calls his "observation house"—which is a birdhouse with a glass side covered with a wooden door—and look at Mama Bluebird sitting on her eggs.

The Doctor is never quite sure which of his little friends in feathers arrives first in the spring—the Bluebird, the Song Sparrow, or Phoebe. Some morning in March, often before the snow is off the ground, he will be awakened by a "pewit-pewee!" before his window. There he will see a seven-inch-long, cream-breasted, black-billed Phoebe, fluttering about the leafless vines of the porch, singing her friendly greeting of just four notes. From under the lilac and syringa bushes he is sure to hear, about the same time, a "tweet, tweet, twittering," for all the world as if someone's pet canary bird had escaped from its cage. That is Mr. Song Sparrow, gray-brown of back and wings, speckle-breasted, busy and cheerful, stopping every now and then to twitter and trill from some low perch. But the Doctor is apt to see the Bluebird first, because of its bright color.

First Arrivals in the Spring

Pretty Mr. Bluebird comes all alone. His sweet solo is something like this: "Here I am; all alone. Oh-oh-I-oh, pu-ri-ty, cher-ish me!" It is the loveliest melody, a little bit sad, until his mate joins him a week or two later. Mrs. Bluebird has the same colors, but they are not so bright. That is the rule in the bird world, as the mother bird must not be conspicuous when on the nest. Papa wears the gayest coat and sings the finest song.

Then Mr. Robin comes welcoming his mate with a happy mellow song. "Chirp, chirp," she answers faintly from the grass: "I'm rather tired from the long journey, dear." "Oh, cheer-up, cheer-up," he answers. Down he drops to her side and perks his knowing head to this side and that, as if to say: "I think I hear a worm!" Suddenly he stabs the ground with his bill, braces his stout legs, gives a jerk—and up comes a fat earthworm for Mrs. Robin's breakfast.

If the Doctor hadn't kept a cow and had a pasture lot for her, with a pond in it, he wouldn't have had some of the red-winged Blackbirds nesting near him. In the cattails and rushes about the pond there was always a colony of these beautiful birds. They strutted and danced and jumped and whistled, "Bob-o-lee! Bob-o-lee!" Often a gay flash of black and white, with a yellow patch on the back of the neck, tumbled up out of the meadow onto the hedge.

The Doctor's little friends had no trouble guessing the name of this jolly chap, for he sang his name over and over, "Bob-o-link! Bob-o-link! Spink, Spank, Spink!" as he flew from one rest to another. The Bobolink, the Doctor told them, is one of the few birds that sing as they fly. The Oriole is a cousin of the Blackbirds as you might guess from his velvet black wings and tail, and his flute-like whistle. He will not build in a house, however, but insists on building a hanging nest far out on a swaying limb, safe from any prowling cat.

The Sweet Singer of the Meadows

But oh, the Meadow-Lark, that nests in the pasture! This little brown-backed and spotted-yellow-breasted singer, with the necklace of jet and white-tipped tail, is the best singer of our grasslands. When you walk along the edge of a clover field he may spring up at your feet, perch on a fence or bush, and pour out a melody like flutes and violins and human voices in vesper hymns. He is not a true lark, however, but a cousin of the Blackbirds, the Orioles, and Bobolinks. He walks like the Blackbirds. He comes in April and sings all summer long, on the ground, on perches, and on the wing. He is one of the very greatest of bird singers, rivaled only by the Cardinal Grosbeak, Mocking-Bird, Nightingale, and the Brown and Wood Thrushes.

There was rivalry among the children as to who should first spy the Scarlet Tanager in the Doctor's garden. A flash of scarlet flame across an open space, and the Tanager was gone! This glowing coal of a bird, with scarlet breast and black velvet wings and tail, really belongs to a tropical family. He seems as strange among our wild birds as an orchid in a meadow. He flits about in silent places, singing a lovely little chant, as sad as the Dove's but of varied melody. To his mate, who dresses soberly in dull olive and yellow, he sings a low, sweet warble. Very soon he too takes off his scarlet and black coat, that attracts far too much attention, and wears a quiet working dress. So, if you see the Tanager in his dress of flame and soot, it must be in the spring or early summer.

Bird Families that Sing Best

The finest singers of America are Thrushes, Blackbirds, and Finches. The Finches all have the canary

AT THE DINNER TABLE



This is a simple feeding device that is very popular with little birds—a platform nailed to the top of a post with a frame to support a shady branch laid over it.

twittering song; the Blackbirds, the whistling bubbling notes. The songs of the Thrushes are pure rich flute melody, and many of them mock the songs of the Warblers, the Finches, and the Blackbirds.

Another sweet singer of the Finch family is a snow-white-and-dead-black short-billed bird, with patches of lovely rose color on the breast and under the wings; it is the Rose-breasted Grosbeak. The Cardinal Grosbeak, or Virginia Nightingale, is the sweetest singer of them all.

The eaves of the Doctor's barn was a great place for Barn-Swallows. A big colony of them skimmed and wheeled about, the sun glistening on their iridescent blue-black forked wings and tails. They chattered, scolded intruders, and sang sweet gossip songs to each other. The Wrens came right up to the house and sang from the roof, the low bushes, and the ground. Bill up, perky tail, jerking about, the merry singer is a nervous little bird and scolds at times. "Five inches of brown fury in feathers," the Doctor called Mrs. Jennie Wren. She scolded everybody about the place. She even scolded Mr. Blue Jay. He didn't get to come near *her* house. Plucky little Mama Wren! She is the grittiest little darling of the whole bird-world.

The King-Bird is as trim as you please in a coat of iron gray, a pearl bib, and an orange-red patch on his head. He cries in a series of shrill harsh sounds, "thsee-thsee-thsee!" He is a cousin of the Phoebe and the Wood-Pewee, belonging to the Flycatcher family. The great Crested Flycatcher is the most interesting of this family, for when its nest is finished it always finds a snake skin, which it winds in the inner lining, hanging the tail outside of its house to frighten the other birds and keep them away. Old Redhead, the dark-blue, black and white Woodpecker, with his red hood, just chuckles and utters a loud whining "chaw, chaw," besides other calls and imitations. His cousin the Flicker, or golden-winged Woodpecker, known by several other names in different localities, laughs and chatters, drums, and plays tag around the tree trunks. You can always know the Woodpeckers by their drumming, the big black Crows by their cawing, the scary-eyed Owls by their *who-who-ing* and the Doves by their melodious mourning.

Ever so many more birds are to be seen in the Doctor's home grounds, as more than a hundred different kinds of song birds visit him every summer. Many of them also stay with him all winter, such as

the Junco, Tohee, Chickadee, Nuthatch, the Downy and Hairy Woodpecker, and even the beautiful Cardinal Grosbeak will not migrate if they can find food and shelter. The Nuthatch is the little bird that gets the wax from the peach or cherry trees, and sticks it all around the opening of its house; it knows the wax is there and can avoid it, while any other birds will get stuck in it, if they try to enter. Most of the birds named belong to the families of the Thrushes and Finches, the Blackbirds, the Wrens, Swallows, Woodpeckers, Flycatchers, and the little Warblers. You can tell what family a bird belongs to by its song and its food habits, more than by its colors or its nest. How many of the Doctor's birds do you know?

The Boys and the Nest Building Party

One spring day each year the Doctor has a nest-building party. The boys bring houses of all shapes and sizes and empty boxes, ready to convert into houses and shelters.

"When our country was new," the Doctor tells them, "and dead timber was not cut away nor old limbs trimmed from the trees, our feathered friends

had no trouble in finding nesting places, but now this is all changed. So if we want to have birds for neighbors, we must put up houses and sheltered shelves in which they can build their nests and rear their young."

The Doctor has to be consulted very often, for even the openings of the boxes or houses must be made just the right size for the particular kind of bird the house is intended for. If the opening is made too large, the Doctor shows the boys how to make it smaller by placing a piece of wood over it with a smaller opening. He explains that when Mrs. Wren fills her box with sticks she leaves an opening for the nest at the lower side of the back of the house, with only a little tunnel passage leading to it, so that even the far-reaching paw of a cat cannot get the baby birds.

"Cats take a terrible toll from our song birds," says the Doctor. "Every cat will catch at least 50 song birds every year, so you must choose

HELPING THE NEST BUILDERS



A handful of wool or cotton placed on a convenient branch is much appreciated by birds at nest-building time. This Yellow Warbler is gathering a tuft for her nest.

THIS STOPS THE CATS



With a simple device like this around a tree in which there are bird nests, your little neighbors are safe from cats and other climbing enemies.

between the cats and the song birds. One can't have both."

The Bluebirds' houses are fitted with hinged bottoms so that the house can be easily cleaned out after the birds have left. Perches are put on below the openings; then, to keep them from warping apart in wet weather, the boxes are wound round and round with wire or hoop iron. For the Woodpeckers, there are sections of tree limbs, which the Doctor showed the boys how to saw open and hollow out, leaving only a knotlike hole for an entrance. The Doctor explains that the cavity must be bell-shaped and at least 10½ inches deep.

"The birds will finish the job," says he, "when we nail it to a tree trunk. Their sharp beaks are especially suited to that very task."

A big soap-box is made into a Martin house. It has doorways cut in each side; then it is divided into compartments and furnished with a good strong platform, for it is to be mounted on a high pole and must be substantial enough to stand through heavy winds. It has to be carefully ventilated without draft, for the house being out in the open sunlight will get terribly hot, and if it is not properly ventilated the young birds will suffocate.

"The Martin," says the Doctor, "is one of the most valuable birds that we have. Its food consists almost entirely of flying insects, the chief of which is the mosquito. One Purple Martin will catch and consume an average of 2,000 mosquitoes in a day, besides gnats, flies, and other insects."

Birds Have Tastes about Houses

Some of the boys make fancy painted houses from odd bits of wood. "We can't have too many," the Doctor says, "as we must give the birds an opportunity to select a location to their liking. All of our song birds raise two broods each year, and most of them three, and they never occupy the same compartment the second time the same season. All houses should have more than one compartment, for it is necessary for them to start their second nest before their young can fly, and thus they can simply move from one compartment to another."

Finally the boys climb into the loft of the Doctor's barn and fit a big box against the window where the Barn Owls pass in and out. The Doctor explains that the Barn Owl is very useful to man, as its food

consists almost entirely of mice, moles, reptiles, and insects. The young of the owls stay in the nest a long time and require great quantities of food.

The Boy and His Air Rifle

One sunny afternoon in June, a tanned dusty-legged boy came to the Doctor's side porch. In one hand he had a soft limp bundle of white and black and rose-colored feathers. In the other he carried an air rifle. A shamefaced lad he was, for not a boy in town would purposely kill one of the Doctor's birds. He had just aimed at the beautiful singer on the fence of the vegetable garden. When scolded by the Doctor, he said: "But perhaps you don't know that this bird was eating your green peas. I saw him."

"Let me see," said the Doctor. He opened the little crop under the rose spot on the breast that would throb with song no more. The crop and the stomach were packed full of "potato bugs" that were eating all the potato plants in the town.

Out on the picket fence the mother Grosbeak had all her babies in a row and was feeding them the beetles. Black-headed Grosbeaks were there too. In a few days the Doctor's potato plants were picked clean, and the birds were foraging in near-by gardens.

"I have found," the Doctor said, "that each kind of bird has its special work to do. Woodpeckers go under the bark of forest trees for wood-boring beetles and grubs. The Cuckoo or Rain-Crow eats hairy caterpillars; the only other birds that can manage these are the Orioles. The Robins clear our lawns; the Bluebirds, Catbirds, and Cedar-Birds forage in the orchards. The Wood Thrushes and Flickers feed on the ground, taking thousands of ants every day. The Meadow-Larks, Bobolinks, and Red-winged Blackbirds hunt in the pastures and swamps. The Swallows, the King-Birds, the Phoebe, and other Flycatchers are raiders of the air. Wrens forage in low plants, shrubs, and in cracks and crannies

A PRETTY COTTAGE FOR TWO



Who wouldn't want to be a bird and go to house-keeping if one could have a beautiful little cottage like this? "When the wind blows the cradle will rock," just as it says in the song.

A WIRE FOOD PROTECTOR



Wire screening fastened in this way serves to hold both food and nesting material. This little cage contains suet. It is protected from crows and squirrels, but this little Brown Creeper has no trouble in getting at it.

HOW TO MAKE OUR FEATHERED GUESTS HAPPY



Purple Martins Prefer Houses with Porches and Good Ventilation



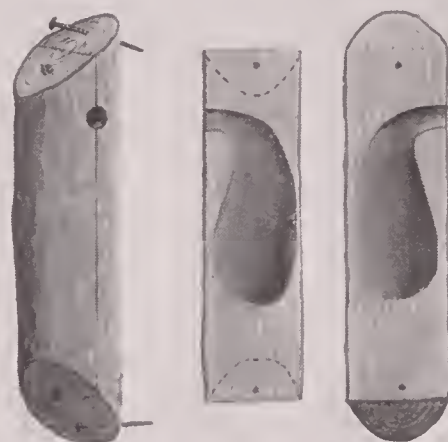
Gourd Houses for Martins, Such as those the Indians Put Up



Tomato Can Houses which Suit Either Bluebirds or Wrens



A Birch-Bark House for Bluebirds



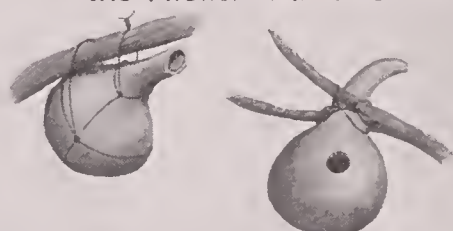
Start the Nest Like This and the Flicker Will Finish It



A Handsome Flicker Residence



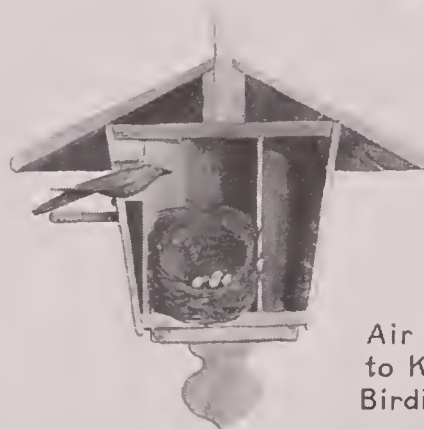
Bark Houses for Flickers, Bluebirds, and Wrens



Gourd Houses for Wrens or Bluebirds



A One-Room House for Bluebirds



Air Spaces to Keep the Birdies Cool

Our little feathered friends are as eager to neighbor with us as we are to have them; but they have special tastes. In the beautiful little Flicker home with the pointed roof you must put some chips and saw-dust, so that when Mr. and Mrs. Flicker see the apartment, they will think they dug it out themselves. Adjoining this Flicker mansion—which in addition to being so handsome is just as deep as the Flicker house should be (10½ inches)—well ventilated and without draft—is a Flicker house that you could make; next one for a bluebird; and further on a wren house. Bluebirds will build in a one-roomed house, but a house with more compartments is much better, since they raise three broods a year and take a new apartment for each brood.

contained in the Easy Reference Fact-Index at the end of this work

of house walls and fences. Hawks and Owls hunt mice and moles. In August all the insect-eating birds make a feast of grasshoppers. One brood of Robins eats half a million insects and larvae in a summer and not a thousand cherries. If fresh water is kept where the birds can drink and bathe, they will not eat the cherries.

How the Birds Helped Keep Down Weeds

"Among the useful seed-eaters," he continued, "are Doves, Pigeons, and native Sparrows, and the Goldfinches, or Wild Canaries. Mourning Doves eat the seeds of weeds and the gleanings of grain fields. Two-thirds of the food of our native Sparrows in summer is insects, the other third is made up of the hard seeds of grasses and weeds. The Goldfinches eat weed and thistle seeds and berries which grow on the shrubs. A very useful bird on a farm is the Quail (Bob-White or Partridge). Two-thirds of its food is weed seeds, the rest harmful insects, and waste grain. The English Sparrow is a pest. It lives in flocks, is dirty, noisy and quarrelsome, fights all of our song birds, tears up their nests, breaks their eggs and kills their young. It drives away our song birds, and lives on us all the year around, eating its weight in grain every day. It is the 'rat of the air' and should be treated as such. Sparrows are good to eat; sparrow pie is a most delicious dish and has often been mistaken for squab pie."

How Nature Punished Men for Killing Birds

For many, many years scattered bird-lovers told their neighbors such things as these that the Doctor told the children. Some of them were laughed at; others only half believed. The song birds became fewer and fewer. Their nests were robbed, the singers killed for their pretty wings. The farmers shot the birds and drove them away. We began to have wormy orchard fruits, army worms, canker and cutworms, tent-caterpillars, boring weevils, flies, plagues of grasshoppers and Colorado beetles. Countless unseen enemies ate up the farm crops, orchards, and gardens, and even the grass on the lawns. We looked everywhere for help except in the air.

Then in different States bird-lovers banded together to arouse public interest in the protection of birds and named their societies after the great bird-lover and naturalist, John James Audubon. These societies furnished newspapers with information about the value of birds; they printed leaflets for use in the public schools; they sent out lecturers, and they made special effort to interest in their work the men who made our laws.

Laws Made to Protect the Birds

And so it came about that our state and national governments began to study our bird friends. Laws protecting game birds had already been passed by most States. Now laws protecting the large group of non-game birds began to be made by the different States to protect their bird citizens, and powerful influences were exerted to discourage or forbid the

slaying of birds for millinery ornaments. Best of all, a federal migratory bird law was passed in 1913, which placed under the care and protection of the United States government all Wild Geese, Wild Ducks, Wild Swans, Snipe, Plover, Woodcock, Rail, Wild Pigeons, and all other migratory and insect-eating birds which did not remain permanently in any state or territory. This law makes it a crime to kill such birds at any time except in the case of game birds, which may be shot during a period of $3\frac{1}{2}$ months after the nesting season is over and the young birds are able to care for themselves.

By a treaty with Great Britain, birds passing between Canada and the United States are protected in the same way. These protective laws do away with many tragedies in the bird world. Now if baby birds starve in the nest or cry themselves to death waiting for the mother who never comes, we may blame the cat or an accident.

Uncle Sam's Refuges for Birds

But bird lovers have been working for more than laws. The bird societies, especially the Audubon Society, with its branches in almost every State, have induced the government to set aside special places for reservations where birds may nest and live undisturbed by human neighbors. The first such bird reservation was Pelican Island, in the Indian River, Florida, set aside by President Roosevelt in 1903. Many other places of little use to man, but especially suited for bird reserves, have been set aside in the same way; until now there are more than 70 bird reserves in the United States, scattered from Florida to the delta of the Yukon in Alaska, and including one of the Hawaiian Islands.

There are community bird refuges too. One at Meriden, N. H., is a tract of 32 acres owned by the Meriden Bird Club; the whole town helps in feeding their feathered pensioners and in furnishing houses and nesting sites for them. Another is "Bird-craft Sanctuary," a ten-acre tract at Fairfield, Conn.

"This is *your* Bird Sanctuary," said one little listener, as the Doctor finished telling about his work.

"Yes," answered the Doctor, "this is a real bird sanctuary, and with a little effort and care we can make every garden a bird sanctuary. In the summer, help them with their nests and give them plenty of water; in the winter give them plenty of food and shelter; and always, in summer and in winter, give them protection. Remember the Bird Lore motto, 'A bird in the bush is worth two in the hand!'"

BIRMINGHAM, ALA. One of the most striking examples of the industrial development of the new South is the growth of Birmingham. Within a generation, from a little town of 3,000 inhabitants, it has grown to be "the Pittsburgh of the South" and one of the leading centers of the iron and coal industry in the country.

The city itself is built partly on the slope of Red Mountain, so named from its outcrop of red hema-

tite iron ore. For many miles this iron ore extends in every direction from the city, in a vein from 6 to 26 feet thick and of indefinite depth. Birmingham is also the heart of the coal and limestone district of the South. Everything necessary for an almost unlimited production of steel at the lowest cost is, therefore, right at hand, and these conditions are building up a great city with a rapidity unparalleled except by Chicago.

The Birmingham district contains 50 blast furnaces and more than half the iron smelters in the state, ranking fourth in the world in the production of iron. It has the largest basic open-hearth plant in the world, except the Carnegie works at Homestead. Other plants and factories include rolling mills, ship-plate mills, foundries, pipe plants, clay-working plants, cement plants, gas engine works, iron and steel bridge works, and planing mills. Birmingham is the second largest shipping point for yellow pine in the South, and is an important cotton market.

Birmingham is a city of wide streets and handsome residences. In the business district are many imposing steel construction buildings, and there are several public parks.

The city is the hub of a group of cities and towns built up by identical interests. A number of these have been incorporated under the name of Greater Birmingham. The town was not founded until 1871, following the discovery of the deposits of coal, iron ore, and limestone. A company bought a tract of land to develop the coal and iron industry and named the settlement Birmingham, after the English manufacturing city. Population, about 180,000.

BIRMINGHAM, ENGLAND. In almost the center of England, 113 miles northwest of London, lies Birmingham, one of the greatest metal-manufacturing cities in the world, and the metropolis of England's industrial district. The town was in existence before the Norman Conquest and the manufactures of the city date at least from the early 16th century, as evidenced by Leland's 'Itinerary' (1538), in which he writes of Birmingham: "There be many smithes in the towne that use to make knives and all manner of cutlery tooles, and many lorimers that make bittes (for boring), and a great many naylor's (nail makers) so that a great part of the towne is maintained by smithes, who have their iron and sea-cole (ordinary coal) out of Staffordshire."

Toward the close of the 17th century Birmingham had gained wide importance as a manufacturing city, due in large part to the extensive coal and iron beds with which it is surrounded. The leading industry today of the district of which Birmingham is the center is metal-working of all sorts—foundry, rolling, stamping, plating, drawing, etc.—and the products include machinery, engines, iron roofs, girders, and all sorts of industrial wares. The manufacture of railway carriages is an extensive industry, and Birmingham is one of Great Britain's chief centers for

the manufacture of automobiles, tires, and accessories. Small arms, watches and clocks, electrical apparatus, brass works of all sorts, gold and silver articles and jewelry, screws and nails, and steel pens are manufactured in quantities, and buttons, hooks and eyes, pins, etc., also constitute a large class of articles produced. Near Birmingham the steam-engine was perfected by James Watt and Matthew Boulton, and the memory of their famous Soho factory is one of the most precious heritages of the town. Population, about 860,000.

BISMARCK, OTTO VON (1815–1898). Three men sat about a table in the house of the imperial chancellor in Berlin. Although the table was filled with good things to eat, the men made little pretense at eating, for they were all nervously awaiting a dispatch from their king, William I of Prussia, who was at Ems. The French ambassador had sought an interview with him there and on its outcome might hang the issue of peace or war.

Presently a servant entered bearing the looked-for message. He handed it to Bismarck, the master of the house, who read it to his two guests—General von Moltke, the chief of the Prussian army staff, and General von Roon, the minister of war.

In telling of the incident afterwards, Bismarck said: "As I read the dispatch to them, they were both actually terrified, and Moltke's whole being suddenly changed. He seemed to be quite old and infirm. It looked as if our most gracious majesty might knuckle under after all. I asked him (Moltke) if, as things stood, we might hope to be victorious. On his replying in the affirmative, I said, 'Wait a minute,' and seating myself at a small table, I boiled down those 200 words to about 20, but without otherwise altering or adding anything. It was the same telegram, yet something different—shorter, more determined, less dubious. Then I handed it over to them, and asked, 'Well, how does that do now?' 'Yes,' they said, 'it will do in that form!' And Moltke immediately became quite young and fresh again. He had got his war, his trade."

France Tricked into War

The dispatch, thus altered, was interpreted in the press to mean that the king had been insulted and had snubbed the French envoy—which was not the case. In both Berlin and Paris the war spirit rose to fever heat, and on July 19, 1870, France declared war. Thus by trickery Bismarck, with his policy of "blood and iron" and his disbelief in democracy and "speeches and majority votes," became the real founder of that German Empire which again plunged the world into war in 1914.

By birth and tradition Bismarck was a member of the conservative German "Junkers" or landed aristocracy. At school he had spent more time in fighting than in studying, and when he lived on his estate his neighbors called him the "crazy" Bismarck because of his reckless actions. But all this changed when he began his long public career.

He once said: "From the beginning of my career, I have had but one guiding star: by what means and in what way can I bring Germany to unity." He early saw that Austria was the real obstacle in Prussia's way, and so he set about humiliating her. When he first entered the Frankfort Diet as the representative of the king of Prussia, only the Austrian representative smoked. Bismarck, wishing to show the importance of his own country, immediately began to smoke. At first the delegates from the other German states were horrified, but they soon followed his example, and Austria lost this mark of superiority.

Building Up the War Machine

Bismarck recognized that Prussia must become a great military power if it would defeat Austria. So he set to work to secure a reorganization of the Prussian army. To accomplish this, for four years he was obliged to wage an unceasing conflict with the Prussian legislature, which refused to vote the necessary funds. His first chance to use his reorganized army came in 1864. In that year a war was successfully waged by Austria and Prussia against Denmark for the possession of the two little provinces of Schleswig and Holstein. As a result of the war the duchies came temporarily under the control of the victors. Then Bismarck unscrupulously picked a quarrel with Austria over the management of the spoils. Within seven weeks Austria was completely defeated and Prussia stood forth the all-powerful leader of Germany.

Although Austria was given a liberal peace, she was forced to consent to a reorganization of Germany in which she was not included. For a time this new organization took the form of a North German Confederation. When Bismarck tricked France into declaring war, as described above, the South German states joined Prussia, and after one of the most humiliating wars in her history France saw the victorious German troops march through the streets of her capital. On Jan. 18, 1871, Bismarck's goal was won with the proclamation of the new German Empire in the French royal palace at Versailles.

For 20 years Bismarck continued to govern the country he had made. He built up its manufactures and its trade until Germany was the leading country on the continent. But when the young William II came to the throne of Germany, he wished actually to rule instead of leaving affairs in the hands of Bismarck. So the old pilot, who had guided the ship of state for so many years, was deposed from power, and the remaining eight years of his life were spent, like Achilles, in sulking in private and in writing the memoirs of his official life.

Bismarck's full name was Otto Eduard Leopold von Bismarck-Schönhausen. He was made count after the Danish War, and a prince after the war with France. The third volume of his memoirs, because of its damaging reflections on Emperor William II, was suppressed until after the revolution which made Germany a republic. Bismarck's published volume of letters to his wife, beginning with the days of the Frankfort Diet, gives us pictures of that affec-

tionate family life which is one of the best features of the German people.

BISMUTH. When the doctor wishes to study the workings of your digestion, he gives you a solution of certain salts of bismuth to drink, and then takes X-ray photographs. Even a small percentage of the salts of this metal causes the outlines of the stomach and intestines to be clearly discernible, and if the photographs are repeated at short intervals a "moving picture" is obtained of the whole digestive process. In this way the doctor learns what is wrong and can proceed to cure it.

Bismuth is sometimes used as an alloy in type metal. Like antimony, it has the peculiarity of expanding instead of contracting when it passes from the melted to the solid state, and this causes the type in casting to press into all the fine lines of the mold and so produce a sharp clear face even on very small types. With lead, tin, and cadmium it forms alloys which melt at very low temperatures. These are used for safety plugs in steam boilers and automatic sprinklers.

Bismuth belongs to the "nitrogen group" of chemical elements. It has been called the "old man" of the family, for it has "outgrown the poisonous quality which begins with phosphorus, is at its peak in arsenic, and decreases in antimony." Certain compounds of bismuth are often used as a medicine and as an antiseptic dusting powder.

In metallic form bismuth has a bright luster and a reddish tinge. It is found both as native metal and combined with other metals. Large deposits of bismuth are located in Bolivia and Saxony, while smaller quantities come from Spain, Norway, Austria, England, New South Wales, Utah, Colorado, and Connecticut.

BISON. The American bison, commonly called "buffalo" (*Bison americanus*) is the largest and most celebrated of all American hoofed animals. Originally it was found on two-thirds of the continent of North America. Its range extended from Mexico to the region of the Great Slave Lake in Canada, and from Pennsylvania and the Carolinas to the Rocky Mountains. Its food was the herbage of the plain and prairie. The number of bison at the time America was discovered has been estimated at from 30,000,000 to 60,000,000. In 1870 the number of survivors was estimated at 5,500,000. The vast herds sometimes derailed trains in the West and stopped boats on the Yellowstone and Missouri rivers. Colonel Dodge reports that, while traveling in Arkansas in 1871, "for 25 miles he passed through a continuous herd of buffalo." The completion of the transcontinental railroads and the introduction of the repeating rifle about this period soon almost completed their destruction.

To the Indians of the great plains, the bison was the most important game animal. The hides furnished him with the material for tepees and robes. He lived a good part of the time on the fresh meat,

THE GIANT BISON OF THE OLD STONE AGE



The Bison or American "Buffalo" disappeared from the prairies a comparatively few years ago, but this huge creature has not ranged the plains since the Ice Age. What we know of him has been learned from remains gathered in museums and from pictures drawn or carved by the cavemen artists who hunted him thousands of years ago. All bisons are woolly, but you see this ancient species is woollier still, as there was need to be in the Ice Age. At that time he roamed both America and Europe. In the same period the Woolly Rhinoceros and the Mammoth were making themselves at home in northern France and the Moose, Tapir, and Giant Beaver in northern New Jersey. You will notice that this royal gentleman (*Bison regius*) wears a beard.

contained in the Easy Reference Fact-Index at the end of this work

which is almost as good as beef; and for winter the northern tribes made a preparation of the dried meat with berries and fats, called "pemmican." This furnished a nutritious and well-balanced ration in small space. The buffalo dung, as in India, was dried and used for fuel. In 1883 the famous Sioux chief, Sitting Bull, and his band of warriors are said to have slaughtered the last thousand head in southwestern Dakota, leaving less than 1,000 head then alive on the American continent, two-thirds of those being in Canada.

The bison's massive head is his most characteristic feature. His bow-shaped back, different from that of the ox, and the unusually long vertebral spines increase the size of his shoulders.

The convex shape of the frontal bone makes the forehead bulge. Over all the bulk of bone and powerful muscles of the neck and shoulders is the great shaggy coat of curly brown fur. The hair on the head falls over the eyes in a thick mane. The forequarters are heavier and higher than the haunches, which are much more lightly built.

They Weigh as Much as a Ton

The adult male stands $5\frac{1}{2}$ feet high at the shoulders, is 9 to 10 feet long, and weighs from 1,600 to 2,000 pounds. The largest specimen of which we have an official record was shot in Montana, in December 1886, by Dr. Hornaday, and may be seen in the mounted group in the National Museum at Washington. A picture of this specimen adorns the ten-dollar bill of our national currency. The female buffalo is smaller, for a large cow does not exceed 1,200 pounds in weight. The horns are short and black, and in the males are thick at the base, tapering abruptly to a sharp point as they curve outward and upward. In the female they are more slender. The hoofs are short, broad, and black. The general color is pale brown, darker on the head and shoulders and underneath. The hair on the forepart of the body is 10 to 15 inches long on the head, 6 to 8 inches long on the neck, shoulders, and forelegs, and 10 to 12 inches under the chin, where it resembles a beard and is so called. The hinder and lower portions of the body are covered with short, soft, woolly hair. The tail ends in a tuft of coarse hair 12 to 18 inches long.

BUFFALO MOTHERS AND BABIES



If these were wild Bisons you would have difficulty in getting a look at their babies, because both the parents and the little ones are very shy. The calves are born in May, or the early part of June, and they get new brothers and sisters only about once in three years.

The long hair on the forepart of the body is permanent but that on the hinder portions is shed annually, beginning in March. By early summer this part of the body is quite naked and very sensitive. In order to escape the attacks of flies and of other insects, the bison seeks out muddy sloughs and

shallow ponds, where it wallows until its body is covered with clay which bakes in the sun and forms a protective armor, lasting for days. The new coat is fine by October, and at its best in November and December. The hide is then valuable as fur. A half-century ago "buffalo coats"—overcoats made of the fur of young bison—were in common use and remarkably cheap. Such coats today would probably

sell for \$500; formerly they sold at from \$12 to \$25. Many a prime "buffalo robe" was obtained from the Indians in exchange for a pound of tobacco or a pint of whiskey.

Under primitive conditions bison herds moved from one feeding ground to another, going northward in the spring and southward in the fall. The southward migrations occurred in immense herds numbering millions of animals. They traveled hundreds of miles, swimming mighty rivers and climbing or descending steep banks, cliffs, and precipices. They followed the same routes year after year usually in single file, making paths that became lasting trails two or three feet deep. The northward movement began in the spring after the calves were strong enough to travel. In this movement they separated into smaller herds, the bulls occupying the outer circle and the cows and calves the inner. When danger threatened, the herd closed in, the bulls facing outward to protect the weaker members.

Gray Wolf Their Worst Foe

The principal enemy of the bison, aside from the Indians, was the gray or buffalo-wolf which hung in packs about the outer edge of the herds, and often succeeded in isolating and capturing a calf in spite of all vigilance. The grizzly bear was the only animal that could ever vanquish a buffalo bull in single fight.

It required heroic efforts to save the bison from complete extinction. It was not until 1902 that

Congress took the first steps toward preservation when it appropriated \$15,000 for the purpose of assembling survivors in the Yellowstone National Park. As the bison breeds readily in captivity its numbers have steadily increased. The Canadian herds now contain over 5,000 head, chiefly in a vast park in Alberta; and there are an additional 2,000 or more in the United States, the largest single herd being in the reservation on the Yellowstone. An interesting hybrid called the "cottalo," part buffalo and part common cattle, has been bred in Canada.

The European bison or *auroch* was common in Europe two or three thousand years ago, but is now reduced to a few herds in the Caucasus Mountains and in a private preserve established before the World War by the Czar of Russia. The European bison is somewhat smaller than the American, and since it lived in forest country it ranged in smaller herds. It is stated on good authority that the males outlive the females about ten years. If this is true of the American species, it explains why in every herd, as many observers have remarked, the bulls always outnumber the cows. By an unusual mischance the first skeleton of an American bison, exhibited in Paris in 1819, contained 15 pairs of ribs. As a result of this freak, which probably occurs only once in many thousands of specimens, the report became current that the American bison has 15 pairs of ribs while his European cousin has but 14 pairs.

The true buffalo belongs to India and Africa and differs from the bison in the absence of the hump on the shoulders and the long hair on the forepart of the body. (See Buffalo.)

BITTERN. Hunters have named this marsh-bird the "thunder-pumper" or "stake driver," for his call sounds like the driving of a stake heard from a distance. Though his note reaches every part of the swamp, Mr. Bittern himself is hard to find, even when he repeats his call again and again. His song is the most remarkable thing about this "genius of the bog," as Thoreau has called him. As one draws near to his hiding place, the one long note seems to divide itself into three syllables,

plunk-a-lunk, and comes with more of a croaking sound, though seemingly no louder than when first heard. The poet Maurice Thompson well catches the spirit of the bird and its haunts in his verses—

Ho, for the marshes green with Spring,
Where the bitterns croak and the plovers pipe,
Where the gaunt old heron spreads his wing
O'er the haunt of rail and snipe.

The bittern's body is about two feet in length and



A Bittern, when it isn't pretending to be dead, is a very live-looking creature indeed; particularly the male, who, as you see, looks as "cocky" as the proud ruler of the poultry yard.

he stands from two to three feet high on his long legs. He has a feathered crown on his head, and the plain brownish feathers of his back are exactly what he needs for concealment among the reeds and grasses of the marsh. His breast is yellowish white.

In the mating season, however, the male is gay with white plumes on the neck or breast. The nest of the bittern is built of swamp reeds, and there are three to five eggs of a brownish-gray color. The baby

birds are exposed to all the swamp dangers, and minks, muskrats, and water snakes keep the watchful mother always on the defensive.

The bittern is common in both Europe and America. The American bittern breeds in British Columbia and Newfoundland and even as far south as Kansas and North Carolina. It winters in the southern states. The "least bittern" is a small marsh-bird, very shy and rarely seen by man. It nests throughout temperate North America and winters from the Gulf States southward.

Scientific name of American bittern, *Botaurus lentiginosus*; of the least bittern, *Botaurus exilis*.



The watchful expression of its yellow eye would be all the sign of life you could detect in a Least Bittern "freezing" on its nest.

BITTERSWEET. Seen against the dry browns of autumn, the bittersweet gives to the woods of most parts of the United States, especially in the Middle West, dashes of glowing color which rival that of any flower. For the bright orange berries, or more properly capsules, burst open when touched by the frost, and curling back disclose the brilliant scarlet fruit within. The bittersweet is a treelike vine which does not cling gently like the ivy, but twines its woody stem about trees with great strength, some-

times killing young saplings. Not only does it twine about other vegetation, but it "often outdoes the kitten that plays with its own tail, twisting its own stems together, frequently into a rope of great strength." The small inconspicuous creamy-white flowers appear in June. The berries reach their full development in September, and if gathered then and allowed to dry, will brighten the house all winter. Scientific name, *Calastrus scandens*.

The European bittersweet (*Solanum dulcamara*) is a totally different vine. It is a member of the nightshade family and bears drooping clusters of blue or purplish flowers, shaped like potato blossoms but much smaller. These blossoms give place to tempting-looking but poisonous berries about one-half an inch long, which turn from orange to red. From the twigs a fluid extract is prepared which is sometimes used in medicine.

BJÖRNSON, BJÖRNSTJERNE (*byörn'st'yër-nā byörn'son*), (1832-1910). "When his name is mentioned it is like hoisting the flag of Norway," so the critic Georg Brandes once said of Björnson, the most loved and the most representative of Norwegian writers. The author of Norway's national hymn, her greatest novelist, and, next to Ibsen, the greatest dramatist of his country, Björnson embodies the finest qualities of the Norwegian people.

He was born in Kvikne, a little village in central Norway, where his father was a Lutheran pastor. He was educated at the University of Christiania, but left without completing his course in order to devote himself to journalism.

His first novel, 'Synnöve Solbakken', published when he was 25, made a deep and lasting impression. It was the first of a series of tales of Norwegian peasant life, written in the simple and charming style of the old sagas. 'Arne', published in the following year, is perhaps the best of all these stories; it contains the beautiful song, 'Over the Lofty Mountains', which first showed Björnson's ability as a poet.

Björnson was also deeply interested in the drama. He was made director of the theater at Bergen, and was granted a government stipend to enable him to travel in Italy, France, and Germany. He wrote a number of dramas based on the history of Norway and then turned, like Ibsen, to the social problems of the day. He took a more hopeful optimistic view of these problems, however, than did Ibsen. As someone has said, while Ibsen expressed the doubt, Björnson expressed the faith of his people. He was less stern and cold, more gentle and sympathetic, than Ibsen.

As a newspaper writer and editor, and as a political orator, Björnson kept in close touch with the life about him and played a prominent part in the affairs of his day. A strong nationalist, he helped to bring

about the separation of Norway from Sweden, which took place in 1905. In 1903 he was awarded the Nobel prize for the most important literary work of that year. Long before his death, in 1910, his books had been translated into English and the continental languages, so that his literary fame was world wide.

Among his best stories and novels are: 'Synnöve Solbakken' (1857); 'Arne' (1858); 'A Happy Boy' (1860); 'The Fisher Maiden' (1868); 'The Heritage of the Kurts' (1884). His dramas include: 'Between the Battles' (1857); 'Sigurd Slembe' (1861); 'Sigurd Jorsalfar' (1872); 'The Newly Married Couple' (1865); 'The Editor' (1874); 'A Bankruptcy' (1874); 'The King' (1877); 'The New System' (1879); 'The Gauntlet' (1883); 'Beyond Our Power' (Part I, 1883; Part II, 1895).

BLACKBERRY. Only in the United States is this fruit-bearing shrub cultivated, though it is abundant in the British Isles, where it is usually known as the "bramble." It belongs to the same genus as the raspberry, from which it is distinguished by its plumper and larger berry, and by the fact that the conical receptacle comes away with it when the berry is picked. More than 25 varieties have been developed in this country, among them a white thornless variety. They are propagated chiefly from suckers and root cuttings. Blackberries belong to the genus *Rubus*. The trailing or low blackberry (*Rubus canadensis*) is often called the "dewberry."

BLACKBIRD. The "four-and-twenty blackbirds" of the Mother Goose pie were singers, but American blackbirds do not sing. Indeed, only the "redwing" has even a musical call. Of the 12 species, only the male birds have really black plumage. The females are rusty gray-brown with light markings and the young are like their mothers.

Most blackbirds love swampy places, and most of them weave their nests fast to reeds close above watery ground. Their three to six eggs are grayish-green, spotted and streaked with brown. They live in flocks rather than pairs, and the father has little to do with the home-building or with the upbringing of his children. In autumn they collect in great flocks, sometimes tens of thousands together, flying from one feeding ground to another and finally migrating south for the winter.

Though blackbirds are accused of robbing grain fields, they more than make up for that by the vast amount of weed seeds and harmful insects they eat.

Of the American blackbirds the "redwing" is the greatest favorite; he is jet black, with gold bordered epaulets of red (for illustration in colors see Birds). The "yellow-headed" blackbird is the Beau Brummel of the family, for he has an orange-colored head and breast, with a touch of white on each wing. The purple "grackle"—the giant of the family, reaching a length of 12 inches—has black plumage with showy

"MOTHER'S BACK FROM MARKET!"



A mother Blackbird is here seen returning to her woven nest among the reeds with a little luncheon for the babies—a nice fat bug.

metallic lights. He is handsome in appearance, but his note is like the creaking of a rusty hinge and he has a bad reputation as a robber of nests. Brewer's blackbird, which is found in the western part of the United States and Canada, is another handsome member of the family.

In Europe the name "blackbird" is given to a totally different bird, belonging to the thrush family, which is a beautiful songster and makes a good cage bird.

Another well-known member of the family *Icteridae*, to which the blackbirds belong as well as the orioles and bobolinks, is the "cowbird" or "cow blackbird." Like the European cuckoo, the cowbird is a parasite, laying its eggs in the nests of other birds. It gets its name from its habit of following cattle to feed on the insects which flee from the browsing herds. Scientific name of redwing, *Agelaius phoeniceus*; of the yellow-headed, *Xanthocephalus xanthocephalus*; of the purple grackle, *Quiscalus quiscula*; of cowbird, *Molothrus ater*.

BLACK DEATH. "I leave parchment for continuing the work if haply any man survive and if any of the race of Adam escape this pestilence." So wrote a despondent English monk in his chronicle, while the terrible plague called the Black Death raged in England in 1349. And well might he despair, for this epidemic swept off at least a third of the population of Europe in four years.

In France the ravages were as great as in England. "It is impossible to believe the number who have died throughout the whole country," wrote a French monk. "Travelers, merchants, pilgrims, declare that they have found cattle wandering without herdsmen in fields, towns, and waste lands. They have seen barns and wine-cellars standing wide open, houses empty, and few people to be found anywhere. In many towns where there were before 20,000 people, scarcely 2,000 are left. In many places the fields lie uncultivated."

Not only did the Black Death carry off large numbers of people, but it also acted very quickly. A person began to shiver, his temperature rose, swellings appeared in the neck, armpits, or groin, and frequently death resulted in 12 hours.

In many ways the Black Death helped to bring to a close the Middle Ages. In England before the plague there were about four or five million inhabitants; when the pestilence had passed away there were only about half this number. Field laborers had become scarce, and those who were left demanded greatly increased wages. Many peasants left the estates of their masters and fled to the towns, or found places elsewhere where their lot was easier. Parliament passed laws to keep wages and prices at their former levels, but these could not be enforced. As a result the old manorial system of labor and agriculture broke down in England and a new system gradually took its place. In the new system the land was either rented to tenant farmers, who paid money for its use instead of giving their services in return, or else the land was retained by the lord and put into pasture for sheep.

The Black Death was only one of the many visitations of that disease which today we call the "bubonic plague." During the Peloponnesian War it broke out in the city of Athens (430 B.C.). In the reign of the Roman Emperor Justinian grain-ships from Egypt brought it to Constantinople. Boccaccio places the scene of his 'Decameron' on the hills about Florence, Italy, during the epidemic of 1347. Defoe describes the outbreak of 1665—the "Great Plague"—in London.

The home of the bubonic plague is in Asia and we now know that it is carried by a certain kind of fleas which live on rats. With the advance of medical science and sanitation its ravages have been checked in the western world, but constant vigilance is still required on the part of health officers at seaports to prevent its revival.

BLACK FOREST, GERMANY. Tales of dwarfs and elves and fairies haunt every valley and wooded height in the famous Black Forest of Germany, for scores of the nursery tales grew up in the mysterious depths of this wooded mountain region.

The Black Forest lies in the elbow formed by the River Rhine as it flows westward from Lake Constance and turns sharply to the north. Stretching away to the north—mile after mile—are the rounded mountains, crowned with stately pines and firs. The trees support a dome of dark green foliage, giving in the half-light an appearance not unlike the interior of a great cathedral, although no handiwork of man ever fashioned so magnificent a temple. In the narrow valleys lie hamlets scattered along the streams, while here and there are isolated dwellings, partly hidden by fruit trees, looking down from sunny slopes or projecting their quaint gables from a forest background. The length of the chain is about 100 miles and its average width is 24 miles. The loftiest elevation is the round-topped Feldberg, 4,898 feet high. To one coming from the towering snow-capped peaks of the Alps, which lie about 100 miles to the south, the Black Forest seems in comparison but a mass of gentle wooded hills.

Unlike the forests of the United States and Canada, the woodlands of this region are beautifully kept. A tree felled by the wind or blasted by lightning is immediately removed, and all broken twigs and branches are speedily cleared away to be used for fuel. The upkeep of the forest furnishes the inhabitants with their chief means of support. Land which in America would be useless waste here supports groves worth thousands of dollars an acre.

Here and there are nurseries in which each spring are planted the seeds of a future forest. The pine and fir predominate, but in order to provide for every locality, other varieties are sown, such as maple, ash, birch, walnut, and even fruit trees. The groves planted by one generation are cared for by the next, and are cut down and sawed into lumber by the third.

The beautiful Danube and Neckar rivers rise in these mountains. Along these and other streams are

THE BLACK SEA AND ITS CHANGEFUL DISPOSITION



Draining nearly a fourth of Europe, the Black Sea just had to be big! In summer its disposition is sunny, but in winter it gets as cross as a big black bear. Imprisoned within those mountain walls, the winds are set whirling in a vast turmoil which causes trouble for vessels. It's a tempest in a tea-pot, in a way; but what a tea-pot—380 miles wide, 750 miles long, and 7,350 feet deep in some places. Probably no body of water of similar size, in spite of ancient belief, is safer for navigators.

little manufacturing towns, where wooden articles—the famous cuckoo-clocks, music boxes, and toys—are made. Cattle graze on the grassy slopes, and the beauty of the region and the picturesque costumes of the inhabitants make the Black Forest a favorite summer tourist resort. The greater part of the Black Forest is included in the state of Baden (see Baden).

BLACK SEA. This great sea, five times the size of Lake Superior and one-sixth as large as the Mediterranean—with which it is connected by the Bosphorus, the Sea of Marmora, and the Dardanelles—lies between Asia Minor on the south and Russia on the north, and between Bulgaria and Rumania on the west and the region of the Caucasus Mountains on the east, and so plays its part in separating—and in uniting—Europe and Asia. For over 2,000 years its waters have been traversed by ships of early pirates, traders, and settlers, and by vessels of modern commerce and war. For Russia the navigation of this sea, with its Mediterranean outlets, is a vital necessity, and it has figured since the 18th century in that country's history. The fact that the Turks were able to block the entrance at the Dardanelles in the World War of 1914-18 tended to prolong that contest and contributed to the downfall of Russia.

Including the Sea of Azof, which is really a gulf of the Black Sea, the surface area is about 170,000 square miles. Its greatest length is 750 miles, its greatest width 380 miles, and its greatest depth 7,350

feet. It has no islands of importance and practically no tides.

The Black Sea drains nearly one-quarter of the surface of Europe. This large inflow of fresh water makes it much less salt than the ocean or even the Mediterranean and sets up a peculiar current. In the upper level of the Black Sea the fresh water flows outward towards the Bosphorus, while in the lower levels the current from the Aegean Sea flows in the opposite direction. Some of the great rivers which find their outlet in the Black Sea are the Danube, the Dniester, the Bug, the Dnieper, the Don (through the Sea of Azof), and the Kuban. The larger ports include Odessa, Kherson, Sebastopol, Trebizond, and Sinope. The Black Sea has the reputation of being dangerous to navigation, especially during the season of winter storms, and the Greeks gave it the name *Euxine*, meaning the "hospitable" or "friendly" sea, by way of euphemism. But it is now believed that the Black Sea is no worse in this respect than other inland seas. It is usually free of ice, even in the coldest weather.

The Black Sea has been navigated from very early periods. The Greeks colonized its shores as early as the 7th century B.C. After the Turks captured Constantinople, in 1453, they closed the sea to all but their own ships. Later, however, Russia demanded and obtained trade rights for its own vessels, but by international agreement the straits were closed to war vessels except those of Turkey.

BLAINE, JAMES GILLESPIE (1830–1893). The “plumed knight” of the Republican party in the zenith of its power, Blaine—like Webster, Clay, and Calhoun—was disappointed in what many thought to be his reasonable expectation of election to the presidency. Born in Washington County, in western Pennsylvania, a precocious boy with a taste for political history and a gift for debate, he was graduated at the age of 17 from Washington College. At 26 he had taught school, studied law, and become the editor of the influential *Kennebec Journal*, of Augusta, Maine. He helped to organize the new Republican party in that state, and was a delegate to the conventions that nominated Fremont and Lincoln in 1856 and 1860.

His rise from membership in the state legislature of Maine to Congress, where he was Speaker for three terms, and then to the United States Senate, was rapid and unbroken. Twice, under Presidents Garfield and Harrison, he served as Secretary of State. In 1876 and again in 1880 he failed to obtain the Republican nomination for President; and when he obtained it, in 1884, he lost the election to Cleveland.

During intervals of retirement from public life he wrote his ‘Twenty Years of Congress’ (1861–1881), a work of considerable historical value. As a statesman he favored a reciprocity tariff policy, and gave increased attention to South American affairs, calling the first Pan-American conference in 1889–1890. He was a great political leader, beloved by hundreds of thousands for his magnetic qualities; but he was equally distrusted by other thousands, even of his own party (called “Mugwumps” in the election of 1884), who regarded him as unscrupulous or corrupt.

BLAKE, ADMIRAL ROBERT (1599–1657). The memory of Blake, the greatest English admiral next to Nelson, is dear to the English people not only for his naval glory and success but even more for the tradition of his chivalrous character and his unselfish patriotism.

Like Sir Francis Drake, Blake grew up in a seaport town in the south of England, but spent nearly ten years studying at the University of Oxford. It is said the examiner refused him further scholarly advancement on account of his short squat ungainly figure. Blake gained wealth, office, and good repute in his native town and was chosen by his Puritan fellow-townsmen as their representative in the Short Parliament.

Blake’s great qualities of leadership first shone with brilliancy when the Civil War broke out in 1642. He at once joined the Parliamentary forces and drew favorable attention to himself, chiefly through the seizure and year-long defense of Taunton, which enabled the Parliamentary party to maintain itself in the west of England.

Blake was now asked to assume a high command in the navy and pursue the royalists who had taken to the sea. He at once built up the fleet and proceeded to hunt the royalists from the high seas. At

Cartagena he caught and destroyed the greater portion of their vessels and captured their last stronghold, the Scilly Islands. Blake was now called on to lead the English fleets in their mighty struggle for the mastery of the seas against the Dutch under the doughty De Ruyter and the famous Van Tromp, who was cruising with a broom at his mast-head to indicate that he had swept the seas clear of Englishmen. In battle Blake showed the same daring and heroic endurance that had already marked him out. He was repeatedly in the most extreme danger, was once severely wounded, and much of the time he suffered painfully from disease. In spite of all, however, Blake and the other English leaders triumphed and Van Tromp was defeated. The English, for the time being, had established their naval supremacy.

The last exploit of the great admiral was his greatest and most daring—the crushing defeat in 1657 of a Spanish fleet in the Canary Islands, under the guns of a castle and six or seven forts. This exploit excited great enthusiasm in England and admiration throughout Europe. After this his health failed rapidly and he died on his way home as he was sailing into the harbor of Plymouth. Blake received a magnificent public funeral and was buried in Westminster Abbey, the first British seaman to be so honored.

BLEACHING. When cotton, linen, wool, and other fabrics are manufactured they contain a certain amount of coloring matter. To give them the snow-white appearance they usually have, they must be bleached—that is, whitened. Many other substances, such as paper, oil, and wax, also require bleaching.

Formerly cotton and linen fabrics were bleached by repeatedly boiling them in caustics and lyes and exposing them to the sun after each boiling. The finely woven white goods which we still call “lawn” got its name from the fact that it was spread on lawns or grass to bleach. This process was very tedious and took nearly half a year. The people of Holland used to excel in this craft, and down to the middle of the 18th century English manufacturers used to send all their linen to Holland to be bleached. The process was shortened from several months to a few days by the discovery, in 1790, of the bleaching powers of chlorine gas, in contact with water.

The most important bleaching agent is the chlorine compound known as chloride of lime or “bleaching powder.” When dissolved in water it releases oxygen. This unites with the coloring matter and forms a white compound, which either dissolves in water and is washed out, or remains in the fabric. Paper, linen, cotton, hemp, and other fabrics of vegetable origin are usually bleached with chlorine. Other chemicals that act in a similar way are peroxide of hydrogen (which is used for feathers, hair, leather, and ivory), peroxide of sodium, and potash permanganate, used for straw and jute.

Wool and silk are usually bleached by chemicals which release hydrogen instead of oxygen, forming compounds which may be washed out of the fabric.

BLIGHT. When plants dry up and shrivel, or turn yellowish or brown, or when the fruit decays early, the plant doctor says that it is probably an attack of "blight." Very often this is caused by a mildew attacking the leaves, but it may be due to a poor supply of food and air at the roots.

Blights of grains are called "rusts" or "smuts," because they make the grain look reddish or black. Some other common blights are "scab" and "rot" of potatoes, "beet-root rot," "peach leaf curl," and "apple scab." (See Mildews and Molds; Rusts and Smuts.)

BLIND, EDUCATION OF. Blind, deaf, and dumb! Can you imagine a more pitiable plight for a two-year-old child? This was the situation of little Laura Bridgman, about a hundred years ago; but, nevertheless, she became a cheerful, happy citizen, and did a great deal for the happiness of others. An attack of scarlet fever in 1831 left her completely shut out from the world, save for her sense of touch, and her life seemed completely blighted.

When she was eight years old, however, Dr. Samuel G. Howe, superintendent of the Perkins Institute for the Blind in Boston, undertook the untried task of developing a mind thus doubly barred. First the child was given a spoon and a fork on which were labels with the raised letters F-O-R-K and S-P-O-O-N. Gradually the connection dawned upon her, and when the labels were removed she could replace them on the proper articles. Then the letters were separated, and patiently she was taught to assemble them again so they would spell the words. This process was repeated with other articles, until finally she was familiar with the whole alphabet, and knew how to spell many names of simple objects.

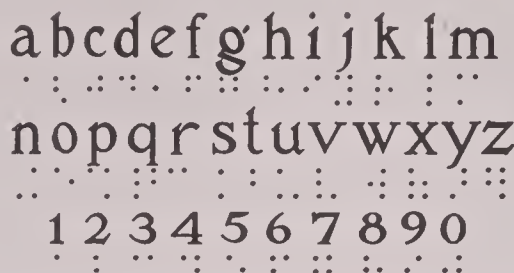
Now she was ready to learn finger spelling. A raised letter would be given her, and, with Laura's delicate fingers "watching" closely, the deaf-and-dumb sign of that letter would be formed by the teacher. Soon she was "writing her thoughts on the air" with astonishing rapidity, and by feeling with her hands the signs made by the person conversing with her, she was soon "talking" with them. This education continued until she was 20 years old, and she developed into an unusually skilful teacher of blind children and was happily employed earning her own living until her death in 1889.

The Beginning of a New Era

Laura Bridgman did not have the brilliant mind of that other famous blind deaf-mute, Helen Keller, and did not achieve such spectacular results (see Keller, Helen). But her education was the greatest accomplishment of the comparatively new art of teaching those similarly afflicted. Up to the beginning of the 19th century, scarcely any attempt had been made to ease the lot of the blind and to teach them to

support themselves. Today by far the greater number of blind persons in progressive countries are educated, independent, self-supporting citizens. For this change much of the credit is due to the blind themselves—to their eagerness to learn and their untiring devotion to their tasks.

Books for the blind now for the most part are not



You see how simple the Braille alphabet is—just a few little dots in various positions that to the sensitive fingers of the blind soon come to convey the precious message of books.

printed in raised letters, but in an alphabet of raised "points" so arranged as to represent the different letters. This method was invented in 1829 by Louis Braille, who became one of the best organists in Paris and a noted educator of the blind. As a child he delighted to play in his father's saddlery shop, punching holes in the scraps of leather with an awl. One day the sharp tool slipped, injuring his eye so severely that

he became totally blind. He thought a great deal about the little marks the awl left in the leather, and the idea came that if the awl were punched only half way through, a dot would be raised on the other side. With this as a basis he worked out a system whereby different variations of groups of little raised dots represented letters of the alphabet, special word and syllable signs, and punctuation marks. Educators seized upon this system, and with modifications it is taught in every country where there are schools for the blind. To persons whose fingers are not sensitive, it seems as it did to the newly blinded soldier, who, running his finger over the page, exclaimed disgustedly, "Aw, it feels just like a sheet of sandpaper." But to thousands who have mastered its characters it has opened a new world of happiness.

Two modifications of "braille" are in general use in the United States—"American braille" and "New York point."

Typewriters have been invented for writing both these systems, and machines for embossing the characters on brass plates, so that any number of impressions may be printed.

Books for the Blind are Costly

A large number of books and several magazines are printed in braille as well as in raised letters. Both kinds of books for the blind are much more expensive than printed books. Dickens' 'Old Curiosity Shop', for example, which can be obtained at the bookstores in prices ranging from 50 cents to \$1.50, costs \$17.50 in braille, and is bound in six fat volumes. So most blind people have to depend on their school libraries, on public libraries in the larger cities which have collections of such books, and on state libraries which make the circulation of books for the blind a part of their work. The United States government aids the work by permitting such books to be sent through the mails under a "frank," that is, without postage.

The alphabet of raised Roman letters in combina-

tion with certain other characters is still valuable for those who are too old to learn the new method or whose fingers are not sensitive enough to learn the point system. But to be legible the letters must be large, and this makes the books too bulky for ordinary use.

For writing braille by hand, a grooved board is used with a perforated metal rule to serve as a guide, and the points are impressed on soft paper with a metal pencil. This is read on the reverse side. Writing braille is a tedious process, so in most institutions for the blind the use of the Braille typewriter is also taught. For writing to the seeing, advanced pupils are taught to use also an ordinary typewriter. The "touch" system now universally used by stenographers was originally devised for the blind. Special touch devices are employed to teach geography, arithmetic, and natural history to the blind.

One of the most wonderful recent inventions, the phonopticon, may soon enable the blind to *hear* the books they cannot see (*see* Light).

The United States government, through the Vocational Education Board, accomplished wonderful results in retraining the soldiers blinded in the World War of 1914-18. Here the work was different from the teaching given in the schools for the children who have always been blind; for blind soldiers, like other adults blinded by accident, are forced into a new sort of life that is overwhelmingly different. They are normal men, forced to live in darkness, and they must "learn to be blind." The vocational schools retrained the majority of blinded soldiers to take a fairly independent place in normal life. The Braille system of reading was taught, and instruction was given in anything the soldiers desired to adopt as a business or a "paying hobby."

Most of the European institutions for the blind depend on charity, but in the United States it is believed that all children, whether normal or handicapped, should receive education as a matter of public policy; so schools for the blind constitute a part of the educational system of the states. Blind children are given much the same sort of instruction as those who can see, and are also trained in some profession or handicraft by which they will be able to earn a living.

Many blind persons are engaged in farming. Many of them excel as musicians, and a considerable proportion of the graduates of schools for the blind become piano-tuners. Basketry and broom-making are other occupations especially suited to the blind.

BLOCKADE. During the Civil War in America, the most daring sea captains of the Confederacy were employed in the effort to break through the lines of Union warships which blockaded the Southern sea-ports. In the dead of night, their low black-painted ships, usually loaded with cotton for the British market, would steal out of the harbors and make a dash for the open sea. But often the creaking of the rigging or the swish of water under the bow would bring a hail out of the darkness; "Ship, ahoy! Haul to, or I fire!" Then the effort to escape would be broken by the thunder of a flaming broadside from a Northern man-o'-war, and it was "sink or swim" for the crew of the *blockade runner*, as these vessels were called. The war measure which closed the Southern ports and ultimately starved out the Confederacy is an historic example of the naval operation

known as "blockade." It extended even to neutral ships, which were liable to seizure if they tried to break through into a blockaded port.

In the Declaration of Paris, agreed to by the great powers in 1856, the principle was laid down that fighting nations could not declare an enemy port blockaded unless they actually carried out the blockade with warships patrolling the approaches to the harbor. "A blockade, in order to be binding, must be effective," was the way the agreement read.

During the World War of 1914-18, sea-mines, submarines, and the development of long-range guns for coast defense made it impossible for the Allies to carry out an actual blockade of the ports of the Central Powers. So the principle of 1856 was modified, and an "embargo" or "long-range blockade" of the enemy countries was declared. Before its entrance into the war the government of the United States refused to recognize the legality of these measures, and engaged in long discussions with England and France on this point. But the far more serious menace to American shipping and lives created by the German "blockade" of indiscriminate submarine sinkings ended the discussions by forcing the United States into war on the side of the Allies. As President Wilson said, "Property can be paid for; the lives of peaceful and innocent people cannot be." (*See* World War of 1914-18.)

BLOOD. If you were to put a drop of your blood under a microscope and examine it, you would find that it was made up of a liquid, called the "plasma," in which floated millions of tiny round bodies. These are living cells and are of two kinds. One kind is red and is called the "red corpuscle." A single drop of blood contains about 170,000,000 of these minute bodies. They are manufactured in the marrow of the bones and are the oxygen carriers. The other kind of cell is known as the "white corpuscle," because of its lack of color. The white corpuscles are much fewer in number than the reds. They are somewhat larger in size and possess the power of changing form and of creeping. They gather particles of foreign substance, and creep with them out of the blood-vessels, and even to the surface of the body. They feed upon bacteria, and help to rid the body of disease germs. They are therefore the *scavengers* of the blood. They are renewed from the spleen and lymphatic glands. A microscopic examination of the blood and counting the number of white or red corpuscles is often necessary as an indication of disease or health in the body as a whole, as, for instance, in appendicitis.

The plasma is a very complex liquid. It contains food products on their way to be used in various organs, and also waste materials on their way to organs of elimination. In general the purpose of the blood is to supply every part of the body with what it needs and remove what it does not need.

The plasma has a peculiar characteristic which is extremely useful. If a blood-vessel is cut or broken

so that the blood is escaping, there is a substance in the plasma which becomes fibrous. This entangles the corpuscles in its meshes and forms a clot; otherwise we might bleed to death. This process is called coagulation.

The weight of the blood is approximately one-twentieth that of the body.

We may compare the circulation of the blood in the human body to the water supply of a large city, with this difference: The city does not gather the water up, after it has once been distributed, and bring it back to the city pumping plant. The body, on the other hand, pumps the blood round and round.

The body station (the heart) is a double one (*see Heart*). The left side pumps oxygenated or "arterial" blood all over the body. This blood loses much of its oxygen in passing through the living organs, and at the same time collects a waste product called carbon dioxide. Therefore, the blood comes back to the right side of the heart as "venous" blood. The right side pumps this venous blood through the lungs. There it takes up oxygen again, and loses carbon dioxide and then passes back to the left side of the heart as arterial blood. Thus the blood constantly goes out but always comes back to the same place, moving—as Harvey, the discoverer of the circulation, said—"in a circle, as it were."

The passage from the left side of the heart throughout the body and back to the right side is called the "systemic" circulation; while the passage through the lungs is known as the "pulmonary" circulation. All this necessitates three sets of pipes or blood-vessels. Those which carry blood *from* the heart are called "arteries," and those which carry blood *to* the heart are called "veins." The extremely small—indeed, microscopic—tubes connecting the arteries and veins are called "capillaries." There are millions of capillaries, and in one sense they are the most important vessels, because in them the exchanges of food and waste take place.

Pure and Impure Blood

We have spoken of oxygen and carbon dioxide as examples of usable and waste materials. It is on the basis of the relative proportions of these two gases that arterial blood is often called "pure" and venous blood "impure." But it should be borne in mind that many other kinds of usable material, mostly so-called foods, and many kinds of waste are collected and distributed. Thus it happens that venous blood from the intestinal wall during digestion may contain more food than the arterial blood supplied to the same organs. The venous blood from the kidney is purer as regards certain waste substances than the arterial blood. So it goes. The blood in every part differs slightly from every other part. The circulation leads to a constant renewal, purification, and mixing of the blood, so that every part gets what it needs and gets rid of what it does not need. The whole body works as a unit, each organ doing its own particular work, and the blood is the go-between.

The blood is at once food agent and garbage man. You may thus get some idea of how important the circulation is.

Regulating the Circulation

Ordinarily the flow of blood to the different organs is very nicely regulated without any conscious work on our part. That is, the organ which is working hardest will receive a greater proportion of blood at the time than the one that is at rest. But we may consciously increase or change the rate of flow from one organ to another by increasing the activity of that organ. This is true chiefly in regard to the voluntary muscles. And we may seriously interfere with the circulation by taking anything into the system which will interfere with the heart action or with blood-vessels, such as drugs of various kinds.

The force of gravity is always acting on the blood, as upon any liquid, tending to pull it into the lowest parts of the circulatory system. Under usual circumstances this is compensated for, and head and feet respectively get their proper amounts of blood. Sometimes the nervous regulation is defective, the blood is drawn away from the brain and the person faints. This type of unconsciousness is at once recovered from when the person is placed flat on the ground, so that gravity cannot pull blood away from the brain.

Through the circulation, also, the temperature of the body is adjusted. If we are warm, more blood goes to the skin. If we are cold, the blood is kept inside and heat loss is diminished. (*See also Heart; Physiology; Respiration.*)

The ancients believed that the arteries contained air, and only the veins blood. The Greek physician Galen, in the second century A.D., demonstrated that both arteries and veins contain blood; but he thought the blood went out and back in the arteries—a kind of ebb and flow—and similarly for the veins, with a different kind of blood. A direct connection between arteries and veins was not thought of. In 1628 Dr. William Harvey, of London, published a book in which he proved that the quantity of blood leaving the heart and the rate at which it leaves made a return to the heart necessary. He did not, however, actually see the minute capillaries which connect arteries and veins. It remained for the Italian Malpighi, in 1661, and the Hollander Leeuwenhoek, in 1669, to demonstrate with the microscope the existence of these minute tubes connecting arteries and veins. If the foot of a live frog is placed under a microscope, the blood may actually be seen flowing through the capillaries which lie in the webbing between the toes.

BLOODROOT. In the warm sunlight of early spring the bloodroot bursts into wondrous loveliness, only to vanish in a day or two when the fragile white petals are swept by the spring rain or winds. While the days are still sharp and chill, it pushes its blossom above ground, wrapped in the protecting cloak of its silver-green leaves, ready to unfold with the first warm sunshine. The plant owes its name to the blood-red juice which oozes from its broken stems and roots. Perhaps grandmother may tell you that she once cured a cold or cough by eating drops of this orange-red liquid on a lump of sugar. The roots of the plant are still used at times in medicine. Long



"In the warm sunlight of early spring the Bloodroot bursts into bloom, only to vanish when the fragile petals are swept by rain or wind."

has 2 sepals and the corolla 8 to 14 oblong petals; there is one short pistil, and numerous stamens. The leaves are rounded, deeply and palmately lobed. The plant grows from a thick fibrous root.

BLUEBELL. Countless allusions in literature to the "bluebells of Scotland" have accustomed us to think of this delicately colored flower as peculiar to that country, but it is no less common in North America and other parts of the Northern Hemisphere. The bell-shaped blossoms droop on their slender stems, so that the petals form a roof to protect the pollen from the rains. The bluebell is a hardy plant and is often found peeping through snow and ice, which are supposed to be melted by its heat.

The bluebell belongs to the genus *Campanula*, which includes about 300 species, among them the familiar "Canterbury bells," all of them popular on account of their bell-shaped blue, violet, or white flowers and the ease with which they are cultivated. It gets its scientific name, *Campanula rotundifolia*, from the roundish shape of its root-leaves.

BLUEBERRY. Like the cranberry, the blueberry is nature's free gift. Our entire market supply of this delicious fruit comes from the extensive patches of wild bushes found here and there in the United States, Canada, and northern Europe. Attempts to cultivate the blueberry all failed until scientists recently discovered that in its wild home it is always associated with a nitrogen-gathering fungus which grows on its roots. Now that the secret has been discovered, growers may perhaps begin to cultivate the blueberry on a large scale to supplement the wild crop, especially as it grows only on poor sandy acid soils unfit for other more valuable cultivated crops.

ago the Indians stained their bodies with the bright dye before a war or peace dance, or used it to color the grasses and quills for their fancy baskets. We find these dainty blossoms covering rocky slopes and gracing the open woodlands during April and May, from Canada to the warm southern climes of Florida.

Scientific name of bloodroot, *Sanguinaria canadensis*; it belongs to the poppy family. Flowers, white with golden center, at the end of smooth stem 6 to 14 inches tall; the calyx

Gathering blueberries is an important industry in many parts of the country, especially in Michigan, Minnesota, and Maine, which contain huge tracts covered with the bushes. The "blueberry barrens" of Maine cover an area of about 150,000 acres. Picking this fruit is easy, for the berries grow in large clusters. Often a patch is burned over to produce a new and more vigorous growth the next year.

Blueberries vary in color from a shiny bluish-black to dark blue with a bluish-gray bloom. In the markets the blackberries are usually called "huckleberries," though the names huckleberry and blueberry are often used indiscriminately. In some localities the "highbush" berry, which grows on a shrub sometimes ten feet high, is called the huckleberry, and the term blueberry is reserved for the choicer fruit of the "lowbush" variety. In England the terms "whortleberry" and "bilberry" are used.

Botanists distinguish two genera of blueberries, *Vaccinium* and *Gaylussacia*, both of the family *Vaccinaceae*, which also includes the cranberry. Some restrict the term "huckleberry" to the genus *Gaylussacia*.

BLUEBIRD. Have you found the "happiness bird"? With his sky-blue coat and his delicate spring song you may see him any early spring day

along the roadside, for like his namesake in Maeterlinck's story he is to be found in common places.

The bluebird is only seven inches long, but he is every inch a gentleman. His dull-red vest and white underfeathers contrast well with his showy coat. His gentle manners are in keeping with his sweet voice, for he is devoted to his mate in her quiet gray-blue dress and he takes his turn with her at keeping the bluish-white eggs warm. When the babies hatch, both parents are tireless in supplying the five or six hungry mouths, and in keeping tidy the hollow post or bird-box home. Unlike many other birds, they carry all refuse to some distance from the nest.

Bluebirds often nest twice each season. Their food is largely in-

sects, though they eat some berries and small fruit. During the summer they are found throughout North America east of the Rocky Mountains as far north as southern New Brunswick. Late in the fall they migrate to the southern states. Among the first birds to come in the spring, the bluebirds are among the last to leave, remaining until the frosts of November.

Bluebirds belong to the family of thrushes. Besides the true bluebird of the east, *Sialia sialis*, there is a western bluebird, *Sialia mexicana occidentalis*, found on the Pacific coast, and a mountain bluebird, *Sialia currucoides*, found in the Rocky Mountain regions.

A BLUEBIRD FAMILY



Did you ever see a prettier family group? On the highest twig sits Papa Bluebird, just below him is Mother Bluebird, and at her side a dear little baby bluebird with its speckled breast.

BLUE-FISH. A salt-water fish of blue color, two or three feet in length, highly prized as food and also as a game fish. (See Fish.)

BLUEJAY. "Thief! thief!" the bluejay shrieks, as he flies through the orchard. Uncle Remus says, "Jay-bird don't rob his own nes'," so his warning must be to the small birds he is about to molest. He is a bold and cheerful rascal, so handsome that he makes us forget his appetite for eggs and young birds. His admirers have tried to clear him of the charge of nest-robbing, but the outcry of his little neighbors when they see him near their homes is evidence against him.

Jays, a group of the crow family, are found throughout a large part of the world. They are smaller than crows and more active. Most species are brightly colored and nearly all show some shade of blue. The common jays of Europe have a body color of reddish-gray with blue and black on tail and wings.

The most showy of the family are our own bluejays. They are about 11½ inches long. Male, female, and young are alike feathered in violet-blue above, white and gray below. A showy crest of blue is outlined by a black band which extends around the neck like a collar. The wings and tail are bright azure-blue, broadly tipped with white and barred with black. Of their manner James Whitcomb Riley says—

Mr. Bluejay, full o' sass
In them baseball clothes o' his,
Sportin' 'round the orchard jis'
Like he owned the premises!

Besides his robber-cry, the bluejay has a clear musical whistle-call unlike the notes of any other bird. His nest of sticks, bark-strips, rags, paper, or any material that is handy, is built in the low branches of a bushy tree, oftenest an evergreen. There are four to six greenish-buff brown-spotted eggs. The birds feed on insects and large seeds, nuts, and some fruit.

Although in autumn there is a general migration toward the south, the bluejay is frequently found in Canada the year around, and in the United States he is a regular winter resident.

Jays belong to the family *Corvidae*, of the order *Passeres*. Scientific name of the bluejay, *Cyanocitta cristata*; European jay, *Garrulus glandarius*.

BOA CONSTRICTOR. Often the name "boa constrictor" is loosely applied to any large serpent that crushes its prey in its powerful coils. But the name properly belongs to two snakes which are natives of tropical South America, the true boa constrictor and the anaconda. The former lives in dry bushy regions, and the latter in swampy places. The boa constrictor sometimes attains a length of 12 feet and the anaconda of 30 feet. Both are to be distinguished from the pythons, which are residents of the tropical regions of the Old World. The boas have no poison fangs, but their powers of crushing are great. They are able to swallow whole animals the size of a small dog. After feeding they remain torpid for several weeks to complete the process of

digestion and during this period they may be easily killed. (See Snakes.)

BOAR. Hunting this ferocious species of wild swine was once one of the favorite sports of kings and nobles, and a special breed of dogs (boar-hounds) was developed for it. The wild boar is larger than most breeds of the domestic hog, and its formidable tusks and savage spirit make it a dangerous foe when brought to bay. It is still preserved for hunting on some great estates in Europe. "Pig sticking," as it is called in India, is one of the most popular sports among British residents there.

This powerful beast is about four feet long and covered with bristles and grayish-black hair. The great tusks of the lower jaw in the adult curve so far over the snout as to become useless, and their place as weapons is taken by the protruding teeth of the upper jaw. The boar lives in the forest and comes forth at night to feed on roots, herbs, grains, and small animals.

Scientific name of European wild boar, *Sus scrofa*. It is found in Europe, northern Africa, and central and northern Asia, is fairly plentiful in Spain, Russia, and Germany, but is extinct in England. The Indian wild boar, *Sus cristatus*, is slightly taller than the European. The "peccary" of Texas and Mexico, a much smaller animal, was the only wild hog found in North America.

BOARDS OF TRADE. A large floor crowded with frantic men, most of them in shirt sleeves, all shouting at the top of their lungs, waving their arms, dashing here and there, stumbling over each other in their eagerness, making strange signs in the air with their fingers, while messenger boys dodge in and out, running at full speed with papers in their hands—this is the scene in the grain exchanges of the large cities in the United States on busy days. They look like madhouses, but it is in the midst of such pandemonium that the grain crops of the country are bought and sold from year to year.

Grain exchanges—called in Chicago the "Board of Trade," in Minneapolis the "Chamber of Commerce," and by various names in other cities—are simply market places. Anyone in any part of the world who wishes to sell or buy grain may do it in these open markets by instructing his broker by mail or by wire how much grain he wishes bought or sold and what price he is willing to pay or take. The exchange organization provides a place where the brokers may meet, and lays down certain "rules of the game" to govern the transactions and take care of whatever controversies arise; but even when the "pit" is crowded with some hundreds of struggling shouting men endeavoring to execute their orders, there is no bickering over details, and there is implicit confidence that the contract will be faithfully carried out. Sales involving thousands of dollars are made by a single word, a nod of the head, or a slight gesture, and each party merely jots down on a little card a memorandum of the transaction.

The price quotations in the leading exchanges are immediately telegraphed to all parts of the world. If differences arise between two markets greater than

the cost of transportation between them, a person may buy in the low market and immediately sell in the high one by telegraphing to a broker in that city, and thus the price of wheat tends to equalize itself. By this process, called "arbitraging," grain prices are kept even all over the world.

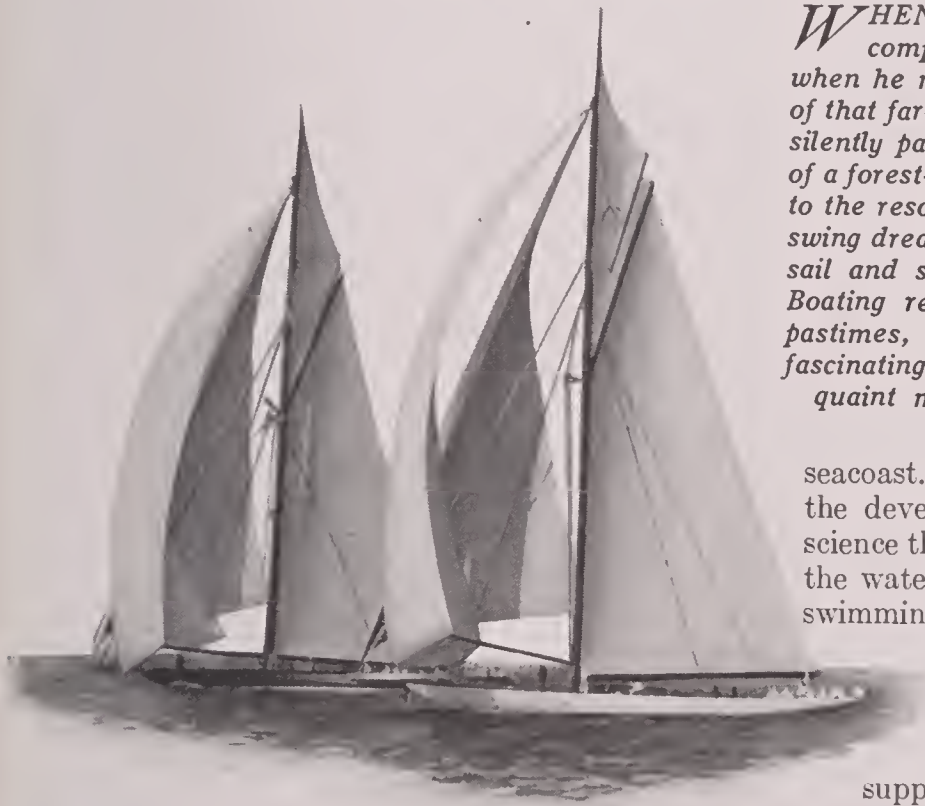
Besides grain growers who sell their produce on the exchange, and others who buy it because they really wish to acquire it for exporting, milling, or other purposes, there is a large class of "speculators" who buy or sell according to whether they think the price is to be high or low. By means of the information which the exchange is constantly receiving from all over the world about the condition of the crops, and weather conditions, wars, or rumors of war which would affect supply and demand, these speculators become very expert in judging whether the price of grain is likely to rise or fall. If the price is lower than they believe is warranted they are quick to purchase grain, which tends to raise the price. If the price seems too high they instantly sell, and this tends to lower it. The price of grain is consequently a very close balancing of supply and demand all over the world, and, in spite of many doubtful practices, the speculators' quick response to market conditions aids in keeping the price near the proper figure.

Perhaps the most important feature of the grain exchange is "dealing in futures." Suppose A, a farmer, makes a contract in July with B, a merchant, to sell him all his wheat which will be harvested in September. B is then the legal owner of this "September wheat," and if he sees an opportunity to sell it to C at a higher price, he will do so. This process may continue until the "future crop" has passed through hundreds of hands, and when September arrives the wheat that A sold B is shipped to the last buyer in the series. If the grain is sold for immediate delivery, it is called "spot" wheat.

"Bulls" and "Bears" of Trade

Those speculators who buy in the hope of selling later at a higher price are called "bulls." Those who sell what they do not possess—"sell short"—in the belief that before the time for delivery arrives they can buy at a lower price, are called "bears." Very often speculators do not buy the grain outright, but pay only a small part of the value of each bushel, called a "margin." This enables the buyer to control more grain than he would be able to buy outright, and thereby gives him a chance for greater profits. If, however, the price of the grain goes below what his "margin" will cover, he must make good the deficit or lose all he has already paid down.

The LURE of BOATS and BOATING



WHEN man first conquered the waters he took a step comparable to that taken thousands of years later when he mastered the air. And something of the thrill of that far-off conquest lingers with us still, whenever we silently paddle a light canoe through the winding course of a forest-hung stream, or dash across a lily-padded lake to the resounding put-put-put of a speedy motor boat, or swing dreamily along an ocean coast beneath the bellying sail and singing rigging of a sailing yacht or catboat. Boating remains one of the most popular of summer pastimes, and no section of a great museum is more fascinating to old and young than that which shows the quaint models of boats of other times and lands.

seacoast. Each age has contributed something to the development of boating until in these days of science there are all manner of craft that plow through the water or glide over the surface, half flying, half swimming. But the pleasure of boating has not greatly changed—it is essentially the same now that it was thousands of years ago, when man first discovered that he could contrive a craft that would support his weight upon the water.

The "Birch-bark" of the Red Man

BOATS AND BOATING. It is a long step from the crude raft of logs tied with vines or rawhide thongs, on which our ancient ancestors paddled their way across the forest streams, to the finely built sailboats and motor-boats that today pass swiftly up and down our lakes and rivers and along the

From the raft to the "dugout" canoe was a big step, from the dugout to the skin or bark-covered craft a smaller one, and no one knows when or how these steps were first taken. The earliest white man who came to the shores of America found the Indians

paddling their graceful birch-bark canoes up and down the streams and even venturing out upon the ocean. A great deal of the exploring which was done by the pioneers was accomplished by the aid of such canoes.

STRIPPING BARK FOR A BIRCH CANOE



Not only the building of the birch-bark canoe, but the stripping of the bark from the tree requires a good deal of skill. Hundreds of years before the white man came the Indians had learned to cut the bark with their stone hatchets and remove it, as you see them doing here.

They were so light in weight that the travelers could carry them long distances over rough trails of the wilderness, and at the same time could transport in them considerable loads of provisions and equipments.

The canvas-covered canoes of cedar which we use for pleasure today are modeled upon the type that the red man devised when he fashioned his craft of birch and cedar and filled its seams with the pitch of the spruce, and like their prototype they are keelless. A canoe suitable for the use of two persons is 17 or 18 feet long and weighs from 60 to 100 pounds. It will float in even a few inches of water and for that reason is ideally adapted for trips up shallow or swift-running streams. For unpracticed users "sponson" canoes are built with air-chambers along the gunwales from stem to stern. These add about 25 pounds to the weight, but the result is a craft which practically cannot be capsized or sunk, thus removing about the only objection to the ordinary

canoe. The canoe is ordinarily propelled by light paddles 4½ to 5½ feet long; but it can also be equipped with a detachable motor. Paddling is quite an art, especially to handle the stern paddle and guide the vessel by a turn of the blade without shifting the paddle from one side of the craft to the other.

There are few pastimes that offer more enjoyment than canoeing. The spring, summer, and fall months find numerous camping, fishing, and hunting parties setting out to the four points of the compass on the northern rivers and lakes, with their "duffle" loaded snugly amidships and ready to spend days or weeks or even months on the forest waterways. And everywhere on the lakes and rivers near the cities and summer resorts thousands of young people find recreation and exercise in these smoothly gliding craft which give the perfection of motion on the water.

On some of the larger lakes and rivers and along the coast where there are protected harbors, canoes are often used for sailing. Equipped with a small lateen sail a canoe will make excellent speed in a stiff breeze, especially if provided with "leeboards" to serve the purpose of a keel. Each year the American Canoe Association holds a regatta in which there are many entries for the sailing races, and in these contests extraordinary gymnastic feats of balancing may be witnessed on the sliding outboard seats which are often used.

Why Every Canoeist Should Learn to Swim

The light construction of the ordinary canoe makes it extremely sensitive to movement on the part of the paddler. For that reason every canoeist should be a good swimmer, though it is true that a capable paddler is not likely to capsize, for he has learned to adjust his body to the craft. One needs only to watch a tilting contestant to see how trustworthy a canoe even of the non-sponson type is, and how difficult it is to capsize one when handled by an expert. In these contests, which somewhat resemble

BOY SCOUTS AND THEIR "WAR CANOES"



If you are a Boy Scout, you needn't be told what a lot of thrill is to be had in helping to drive a "war canoe" through the water in a race against another. In this picture are shown two of these "war canoes" and other craft near a Boy Scout summer camp.

the jousting bouts of mounted knights, each canoe is manned by a paddler in the stern and by a tilter who stands in the bow armed with a long pole, the end

SOME PRIMITIVE TYPES OF WATER CRAFT



One of the most extraordinary craft ever built is the canoe (4) used in the Santa Cruz Islands, a group near the Solomon Islands. It has a long platform erected at right angles to the dugout with a living-house at the end supported by the outrigger. Other strange craft shown above are (1) an Eskimo kayak; (2) a goafah, used on the Tigris; (3) a coracle such as the early Britons used; (5) a catamaran with an outrigger; (6) an inflated bull's hide used by the natives of India for crossing rivers; (7) a balsa, or large raft, used by natives on the coasts and rivers of South America.

contained in the Easy Reference Fact-Index at the end of this work

of which is heavily padded. The object of the contest is for one crew to capsize the other. It often happens that a vigorous thrusting and parrying with the tilting poles continues for many minutes before one of the canoes is put out of the combat.

The Indians sometimes built large canoes in which many warriors paddled. So today, imitating the red man, there are "war canoes," built for boys' camps, to be manned by a dozen or more paddlers, who develop a high degree of team work in preparation for races with other canoes.

Boats differ from canoes chiefly in being propelled by oars instead of by paddles. Greater force of course can be exerted with oars than with a paddle, but the rower is at the disadvantage of having to face backward instead of forward. The types of boats for pleasure and use are legion, ranging from the long narrow racing sculls through the light Adirondack guide boat and ordinary skiff, to the heavy "dories" of the North Atlantic fishermen and the life-boats of ocean liners and the life-saving service.

The one-man sculls are extremely light boats of a long narrow build, with sliding seats and out-rigger oars. In the four-oared and eight-oared shells such as are used by school and college crews in boat races, each man pulls a single oar. Almost all of the colleges and universities which are established near water have their four- and eight-oared crews, and there are many private boat clubs which are represented by similar crews.

Training for the Races

The racing season is in the spring of the year. A great deal of time is spent by the candidates in training for the races, for there is probably no sport in which form and condition count more largely than they do in rowing. The person who combines strength with such a mastery of the stroke that he gets the full power of his body into each sweep of the oar is the one who usually "makes the crew." Weight is an advantage, of course, but it sometimes happens that candidates who are light win positions from rivals of much greater weight but less skill.

The races between eight-oared crews are the most important events of the intercollegiate regattas. Each crew consists of eight oarsmen and a coxswain who handles the tiller. The standard of skill is high, and in such races as the annual events between Harvard and Yale on the river Thames, in Connecticut, the two crews will often row side by side nearly the whole length of the four-mile course. The time for the four-mile race is usually between 20 and 22 minutes. The record for the course—20 minutes and 2 seconds—was made by the Harvard crew in 1916. Cornell holds the record for the four-mile eight-oar intercollegiate race, held on the Hudson River course at Poughkeepsie, covering the distance in 1901 in 18 minutes and 53 1-5 seconds. Occasionally international races are arranged between club or university crews in the United States and crews in England, where also boating is a highly developed sport.

Some of the girls' colleges, too, make rowing a regular part of their athletic program. Eight-oared crews are selected in competitions that are similar to the competitions for the varsity crews in the men's colleges, but the races are not such severe tests of strength and endurance. The races, moreover, usually take place between crews representing various classes within the college, rather than between crews representing different colleges.

In the ordinary rowboat, of course, the rower uses two oars. Along the seacoast and on the inland waters a small skiff will furnish an immense amount of enjoyment and provide boys and girls with excellent exercise as well as a safe pastime—if ordinary precautions are taken. Rowing develops the back, leg, and arm muscles, and it is rare to find a good oarsman who does not possess an excellent chest development.

Pleasure Boats with Sails

Sailing does not offer, perhaps, quite so much opportunity for exercise and physical development as rowing, but there is no question about the fascination of the sport and its health-giving qualities. Between the "dory" sailboat 12 or 15 feet long, the broad flat "cat-boats" with a single mainsail, and the great sloop-rigged racing yachts, there are many gradations in size, speed, and amount of sail carried. The smaller boats usually depend upon a "center board" or "drop keel" to enable them to sail "in the wind," while the larger ones are keel vessels.

A high degree of skill is demanded of one who handles a sailboat cleverly. He must know what sails to use and how to use them under a great variety of conditions, and must develop not only a keen sense in steering the boat but also must have the ability—especially in light winds—to find streaks of wind which will send his boat ahead of competitors. Along the seacoasts, on the Great Lakes, and on some of the smaller inland waters yachting is a favorite summer pastime of many young people. Races are held for boats of various classes and suitable rewards are given to the winners.

The Races for the America's Cup

The acme of all sailboat racing comes with the arrival in American waters of a challenger for the America's Cup, which the United States has successfully defended since 1851. The scene of these international races is the gathering place for yachting devotees and people from all parts of the country to see the slim 90-foot vessels with their towering masts and billowing sails contend for the famous cup. Crews trained in all the *finesse* of sail handling, helmsmen who know how to steer their boats with extraordinary skill, and skippers who have an uncanny way of finding wind streaks and of maneuvering their boats into favorable positions handle the challenger and the defender. It speaks well for American yachtsmen and American designers of boats that the cup has not left our shores in so many years. Only less notable is the fine spirit of sportsmanship displayed by Sir

Thomas J. Lipton, the great British tea merchant, who again and again, in spite of defeat, has devoted his fortune to renewing the challenge which may return the cup to Great Britain. One of the reasons for America's success in these competitions is that so many young people take an interest in yachting that there is a constant supply of "talent" to take the place of the yachtsmen who retire. There are many yacht clubs in American waters, and the number of persons who take part in this healthful and interesting pastime is constantly increasing.

In recent years gasoline motor-boats have been increasingly used both for business and pleasure. The simplest form of motor-boat is the small craft equipped with a detachable one-cylinder engine, which sends it along at the rate of a few miles an hour. Sometimes, as has been stated, these light motors are even put in canoes. Between a comparatively small but serviceable little craft and the motor-boat equipped with a powerful engine which drives it through the water at 30 or 40 miles an hour, or perhaps even faster, there are even more gradations in size and speed than there are between the small sailboats and the cup defenders mentioned above. Most of these motor-boats are driven by gasoline engines especially designed for service in boats; some, however, are equipped with automobile engines. There are also many freak boats such as the "sea sleds" which glide along the top of the water at a terrific speed. Motor-boat races form one of the most exciting contests of the regattas which take place at many points along the shore and inland waters.

Whether it is canoeing, rowing, sailing, or motor-boating, sport that takes one out upon the water in the summer brings many joys and provides zest and stimulation that increase one's health and physical development. There is an instinctive desire in almost all of us to play upon the water; we manifest it as soon as we are able to toddle down to the shore, and it remains with us all of our days, giving us pleasure and

healthful recreation whenever we are able to indulge it.

One of the most curious of primitive boats was the round "coracle," which Caesar found in use when the Romans invaded Britain, and which is still used

in certain lakes of Ireland and by Welsh fishermen. It is an open saucer-shaped vessel, usually large enough for one man only. A skin or other waterproof covering is stretched and fastened over a frame made of thin strips of wood laid across one another, tied together, and bent upward.

A boat similar to the coracle is the "goofah," a queer circular basket-like craft of the East, in which, some say, Moses was set adrift. It is still in use in the region of Bagdad on the Tigris and Euphrates rivers. It is about six feet in diameter, woven

from willow twigs, and smeared on the outside with bitumen to make it water-tight.

Boats of a very different type, resembling in shape the Indian canoe, are made by the Eskimos. Those used by a single man for sealing or fishing, called "kayaks," are made by covering a strong light frame-

work of bone or wood with skins. The boat is decked over except at the center where a hole is left for the occupant, who laces himself tightly in with a skin apron, when seated, to prevent the water from entering. Though frail, these boats are very buoyant, and a skilful boatman can capsize his kayak with a twist of the paddle and turn completely over under water. A large undecked boat constructed of skins, called the "oomiak" or "woman's boat," is also made. While clumsier, it has the advantage of carrying a large number of persons and considerable loads of goods.

In the Pacific islands and elsewhere a sort of raft called the "catamaran" is much used, made by lashing together three

or more logs. Though crude, it is able to travel through rough seas where modern craft would be unsafe. The name "catamaran" is also applied to boats with "outriggers" of varying forms, which serve to stabilize them; and to double boats, which have often been built in the United States. It is

A CANOE, TENT, AND COT



An ingenious combination of tent, canoe, and cot. The tent and the cot tuck away in the canoe when you are on the water.

A CAMBRIDGE "EIGHT" IN ACTION



The annual boat race between Oxford and Cambridge is the big event in university athletics in England. Here a Cambridge "eight" is in the lead, keeping stroke to the call of the coxswain, who sits in the stern and steers the light "shell."

practically impossible to capsize such craft, and long sea voyages were made in them.

In 1865 John MacGregor, a Scotchman, invented a wooden canoe known as the "Rob Roy," built somewhat like the Eskimo kayak, being entirely decked over with the exception of a cockpit in which the canoeist sat. It was strong and light enough to be carried over land, so it could be used for long journeys. It was propelled by a paddle grasped in the middle and with a blade at either end.

The making of a "dugout" canoe by savages without adequate tools required much skill. Usually a suitable log was shaped roughly on the outside with axes, and the interior was then burned out. A week or more was required for this operation, as the coals had frequently to be renewed or shifted from place to place, while the wood was dampened here and there to guide the course of the fire. The final shaping was then done by axes and other tools.

The birch-bark canoe of the North American Indians reached the greatest perfection in canoe building. Although light enough to be carried by one man, it is so buoyant that it will bear a considerable load. It is made by covering a light but tough framework of wood with sheets of birch bark, which are sewed together and made waterproof in the seams with resinous gums. The work was done largely by the women, and great skill was required to separate the bark from the trees in large sheets—usually in the spring—and in shaping and sewing it with fibers.

BOBOLINK. Like the little girl in the nursery rhyme, when bobolink is good "he is very, very good, and when he is bad he is horrid." In northern states where he goes and wins his mate, he is known as "the gladdest bird that sings," and his habits of life are above reproach. His tinkling song, "bob-o-link, bob-o-link, spink, spank, spink," is heard over every meadow as he flutters excitedly above the grass where the tiny nest is hidden.

Half of his seven inches is tail. The small graceful body has jet black under-feathers that cover the face like a mask. Buff upper feathers and markings of light on wings and tail give him a showy suit (for illustration in colors see Birds).

The bobolink family of four to seven children are fed almost entirely on insect-pests and weed seeds,

and are considered desirable and valuable citizens.

But when the nesting season is over a transformation takes place. Bobolink exchanges his handsome black and buff for a streaked sparrow-like suit such as his mate wears. He exchanges his northern meadow for a southern plantation, and his insect diet for one of ripening rice. He even changes his name, for in the South, where these birds in flocks of thousands stop on their way to South America, they are known as rice-birds.

Here the bobolink is at his worst. Not content with all that he can eat, he wastefully breaks the stalks and scatters the grain. He is such a menace to the farmer that men and boys are hired to drive him from the fields. The slaughtered birds are considered a great table delicacy when dressed and broiled.

The long migration of three months ends in southern Brazil, where for five months these birds do nothing but eat and be merry. Late in March the males put on their mating feathers and the flocks start northward. When they reach the southern plantations they again yield to their appetite for rice, and swooping down on the newly sprouting fields, uproot the tender green plants and eat the root grain. Then, like outlaws fleeing from justice, they fly to the North where on their good behavior they are always sure of welcome and protection.

Bobolinks, with orioles and black-birds, belong to the family *Icteridae*, of the order *Passeres*. Scientific name of bobolink, *Dolichonyx oryzivorus*.

BOBWHITE. The common name for the most familiar American species of quail. (See Quail.)

BOER WAR. On Oct. 11, 1899, war broke out in South Africa between the independent Boer republics of the Transvaal and the Orange Free State on the one side, and the British Empire on the other. Only after three years of the hardest fighting were the British able to conquer their sturdy backwoods opponents.

The Boers were descendants of Dutch colonists in Cape Colony who had "trekked" northward in 1836 and afterwards, to escape British rule following the passing of Cape Colony into British hands. A conflict with the Transvaal Boers had occurred in 1881, in which the British suffered a defeat at Majuba Hill; this was followed by treaties (1881 and 1884)

THE MERRY SINGERS OF THE FIELDS



Meet Mr. and Mrs. Bobolink. They are newly married, and as you see, Mr. B. is wearing his wedding dress of black and buff, while Mrs. B. has on her streaked sparrow-like gown.

in which it was agreed that the Transvaal should have complete self-government in internal affairs, though in external affairs it should be under the suzerainty of Great Britain.

Then in 1885 came the discovery of rich gold mines in the Transvaal, and a flood of foreign and British adventurers poured in. The Boers remained chiefly rude farmers and stock-raisers, and friction with the *uitlanders* ("outlanders") followed. An ill-advised raid by Dr. Leander S. Jameson (in December 1895), to aid the *uitlanders* against the oppressive measures of President Paul Kruger only made matters worse. A birthday cablegram from the German kaiser to President Kruger led the Boers to believe that they might count on German assistance, and in 1899 war ended the long-drawn-out negotiations. The Orange Free State joined the Transvaal in arms, and many liberals throughout the world sympathized with the Boers' fight for independence.

The vigor of the Boers and the distance of the conflict from Europe taxed the resources of Great Britain as they had never been taxed since the days of Napoleon. Her foes were trained to the use of weapons since boyhood, and fought in a country where they knew every pass and "kopje" (hill). There were no great battles, and the war was mainly a series of ambushes, traps, and sieges—of Ladysmith, Mafeking, and Kimberley especially. For the British, Lords Roberts and Kitchener were eventually put in chief command, while the Boers fought under generals Christian de Wet, Louis Botha, Joubert, and Delarey.

Excellent marksmen and horsemen though they were, the Boers were unable to resist the stream of men that Great Britain poured into the war. On Feb. 27, 1900, General Cronje, one of the Boer leaders, surrendered with 4,000 men. On March 13 Lord Roberts entered Bloemfontein. On May 1 the advance began on Pretoria, the Boer capital. At Spitzkop, on September 8, General Botha fought the last set battle of the war.

From that time until the war's actual end, the Boers led by De Wet, Smuts, and others harassed the British with guerilla tactics. Because of the obstacles placed in the British path by the non-combatant population, concentration camps were established where the high rate of mortality among women and children prisoners aroused world-wide criticism.

By the treaty of Pretoria (May 30, 1902), which ended the struggle, the Transvaal and Orange Free State became British colonies. But self-government was soon restored, and in 1909 these former enemy countries became equal members with Cape Colony and Natal in the South African Union, and Gen. Louis Botha—the former Boer leader—became the first prime minister (*see* Botha). The British had employed 450,000 men in the war, losing 1,100 officers and 22,800 men killed, wounded, or missing, and 43,616 sent home as invalids. The total Boer force was about 95,000. (*See* Rhodes, Cecil; South Africa.)

BOHEMIA. Persons of unconventional habits and more or less artistic or literary tastes are sometimes called "Bohemians." But the real inhabitants of this ancient kingdom—now the chief part of the Czecho-Slovak republic—are a busy hardworking people, as far removed as possible from their flighty namesakes.

Bohemia lies very nearly at the center of the European continent, and is roughly rectangular in shape. It is bounded on three sides by mountain chains (the Bohemian Forest, Ore Mountains, and Sudetic chain), and on the fourth side by the Moravian hills. Since early in the Middle Ages its inhabitants have been chiefly Slavs (called Czechs), but there is a numerous German minority along the northern borders.

The king of Bohemia early became one of the seven electors of the Holy Roman Empire. In the 14th century, Bohemian kings of the Luxemburg line were also emperors, and Bohemia was one of the most flourishing countries of Europe. The University of Prague (the capital), which dates from this period (1348), is one of the oldest in Europe. The Hussite wars of the 15th century, which grew out of the religious teachings of John Huss, left the power of the kingdom greatly impaired. After 1526 Bohemia was a possession of the Hapsburg house. The Thirty Years' War, which started in 1618 with a Protestant revolt in Prague, left the land terribly wasted and Protestantism crushed.

In the 19th century there was a revival of the Czech literature and Bohemian nationalism, which manifested itself in unsuccessful revolt against Austrian rule in 1648, and successfully in 1918, in the course of the World War. (*See* Czecho-Slovak Republic.)

BOLEYN (*bŭl'in*), ANNE (1507–1536). The second queen of Henry VIII of England, Anne Boleyn, was made a romantic figure in history by her tragic fate. She was the daughter of a noble of Henry's court, but was educated in France. She became maid of honor to Queen Catherine soon after her return from France, and was so unfortunate as to attract King Henry by her gaiety and beauty. Divorcing the Spanish princess who had been his queen for 20 years, Henry married Anne. But soon his fickle fancy turned to Jane Seymour, and he was ready to believe scandalous tales which were whispered of his young wife. Condemned on the charge of unfaithfulness to her royal husband, Anne protested her innocence to the last. She went to her death on the scaffold, while still a beautiful young woman of 28, with pathetic courage. "My neck is small enough," said she, spanning it with her fingers, when assured that the headsman would do his work skilfully and with little pain. As a lasting claim to fame, she left to the world her two-year-old daughter, who became the great Queen Elizabeth.

BOLIVAR, SIMON (1783–1830). "The Washington of South America" or "the Liberator" are the

titles given this great South American statesman and general, because it was he who organized and led the revolutions which, after 300 years of misrule, freed Venezuela, Colombia, Peru, and Bolivia from the power of Spain. Born in Caracas (now the capital of Venezuela) of a noble and wealthy Spanish colonial family, he was studying law in Madrid when Napoleon overran Spain and temporarily broke her power. All Spanish America realized the opportunity to emulate the United States of the North and struck for freedom.

Hastening home, Bolivar put himself at the head of the patriots of Venezuela. The successful insurrection in Caracas, in April 1810, was followed within

spirit Bolivar resigned his offices in 1829 and retired to Cartagena (Colombia). He died the next year, at the early age of 47 years. Not until long after his death were his character and services truly estimated.

Obliged for a time to assume dictatorial powers, Bolivar was a sincere patriot, devoted to the cause of liberty and equality. His private fortune and the large sums voted to him were spent for military supplies and in the liberation of slaves. President Monroe trusted him and gave him timely aid by recognizing the new republic, and announcing the "Monroe Doctrine," which notified European governments to keep hands off. Bolivar was buried in

THE LARGEST LAKE IN SOUTH AMERICA



If we were really on the water we are looking at, we should be more than 12,000 feet above sea level; for this is Titicaca, the highest lake of its size in the world. As there is no wood hereabouts, the natives weave those boats of reeds. They are very substantially made and are used to carry merchandise and fish to various parts of the lake.

a month by rebellion in Argentina and Chile. Soon the continent boiled into revolution. For the next 20 years Bolivar led a life of romantic adventure. Between victories and disastrous campaigns, he was alternately the conquering hero with an army and autocratic power, and a deserted fugitive pursued to the West Indies by hired assassins. He reached the pinnacle of his glory in 1828, when he was president of three countries which he had liberated: the republics of Colombia (then comprising Venezuela, Colombia, Panama, and Ecuador), of Peru, and of Bolivia—the latter formed from southeastern Peru and named in Bolivar's honor.

The spirit of disunion and opposition, however, was strong, and in broken health and bitterness of

Caracas, where the centennial of his birth saw a triumphal arch erected to his memory.

BOLIVIA. A disastrous war with Chile which ended in 1883 stripped this mountain republic of South America of its rich nitrate-bearing province on the Pacific seaboard, together with the port of Antofagasta, and since then Bolivia has had no coast line. Although the fourth political division of South America in size, its population is reckoned to be less than 3,000,000. Boundary disputes with its neighbor Paraguay make its area uncertain; official estimates vary from 514,000 to 562,000 square miles—about as large as all the states of the American Union bordering on the Pacific, with the addition of Nevada and Arizona.

LA PAZ, THE CAPITAL ON THE ROOF OF BOLIVIA



Twelve thousand feet above sea level—a height so great that the visitor finds even walking hard work—stands La Paz, the world's highest capital. Frowning mountain walls a thousand feet high encircle it, and far above it tower the white slopes of Illimani, one of the giants of the Andes. Although it is in the tropics, La Paz lies at such a height that the cold at night is often intense. The barren grandeur of the surrounding mountains, the dazzling sunshine, and the brilliant colors of the houses make a sight such as can be seen nowhere else in the world.

The population is less than four to the square mile, and is distributed principally through the lofty plateaus of the Andes Mountains, which here reach their greatest width and tower to enormous heights. Although Bolivia lies in the torrid zone, these high table-lands, most of them more than 12,000 feet above sea-level, have a climate almost arctic in its severity. (See map under Brazil.)

Potosí, where Bolivia's greatest silver and tin mines are located, is the highest town in the world (14,350 feet above sea-level), and frosts occur there every night. Sucre is supposed to be the capital, but La Paz is the actual seat of the government. It is the loftiest of the world's capitals, its elevation of over 12,000 feet giving it an annual average temperature of 50 degrees. There is no coal or timber at these heights, and fires are rarely used, except for cooking. The only fuel is a large woody-rooted plant called *yareta*. The great central table-land is extremely arid and the few hardy crops fail unless the rains are abundant.

Lake Titicaca, a great inland sea about the size of Lake Erie, lies partly within Peru and partly within Bolivia. It is the largest lake of South

America, and one of the loftiest in the world, having an elevation of 12,644 feet. Its intensely cold waters are frequently swept by furious gales. Regular steamer service connects the two extremities. Not far from the Bolivian end lie the vast ruins of Tiahuanaco (*te-ä-wä-nä'ko*), the work of a mysterious Indian race of unknown antiquity, antedating by centuries the Inca semi-civilization (see Incas).

On the eastern slope of the Andes the river valleys fall away in beautiful fertile slopes. Between 9,000 and 5,500 feet the temperature is delightfully mild and the vegetation is varied and abundant. Below 5,500 feet great undulating plains stretch east and northeast to the borders of Brazil, and southeast to Argentina and Paraguay. Here lie trackless swamps, vast grassy pasture-lands, and dense virgin forests. In the valleys, known as *yungas*, and in the lowlands the climate is sub-tropical and tropical. The soil is amazingly fertile, and with the development of transportation and increase in population, these regions, which comprise about three-fifths of the country, can be made one of the garden spots of the world. Here are grown Bolivia's principal crops—sugar cane, coffee, cacao, corn, wheat, beans, rice, and fruits.

The rubber forests of the lowlands are enormously productive, and Bolivia ranks next to Brazil as a rubber country. The forests contain many beautiful cabinet woods, which will gain commercial importance when these districts are opened up.

Of the Bolivian animals the most interesting are the guanaco, the llama, the alpaca, and the vicuña, all of the camel family, but smaller than their relatives of Africa and Asia. The llama and the alpaca have been domesticated, the former as a beast of burden and the latter for its fine wool, which is a staple export (see Alpaca; Llama). All the characteristic animals of the Amazonian tropics occur in the river basins.

Mineral wealth of incalculable extent lies buried in the Bolivian Andes. Much of the gold and silver of the ancient empire of the Incas came from the Bolivian mines, and the yield since the days of the Spanish conquerors exceeds in value \$5,000,000,000, it is said. Bolivia also produces one-quarter of the world's tin, and there are valuable deposits of copper, wolfram, tungsten, lead, antimony, bismuth, and many other metals, besides precious stones. Indications of petroleum have been found in many places. Until the railway facilities are extended, however, this wealth must remain comparatively untouched. Many mines still have to send their ores to distant railways in 100-pound loads carried by llamas.

To serve her vast area Bolivia has less than 1,500 miles of railway. Construction is exceedingly costly, because of the difficulties of the Andean routes. Most of the projected lines are to connect the uplands with the eastern lowlands, so that the crops raised on the fertile valleys and plains adjoining Brazil and Argentina may be transported to the bleak barren mountains to support a larger mining population. Seven thousand miles of navigable rivers provide the chief transport in the eastern regions.

Fifty per cent of the population of Bolivia is of pure Indian blood, about 12 per cent is white, and the *cholos* or half-breeds compose the remainder. Eighty-five per cent of this population is distributed over the great central plateau, where the enormous distances prevent the development of a unified national spirit. Probably fewer than 10 per cent can read and write. But of recent years a determined effort has been made to grapple with this difficult problem, and many a boy is today bending over an American desk that had to be carried hundreds of miles to the remote interior on mule-back.

The government of Bolivia is a highly centralized republic. The electorate is small because it is restricted to those who can read and write, and own real estate, or have a fixed income. There is a congress with two houses, but the chief power is the president, who appoints his ministers and the prefects (governors) of the ten departments.

Under Spanish rule Bolivia formed part of Peru. After about 15 years of insurrection, the Bolivians gained their freedom in 1825, and took their name in honor of General Simon Bolivar, the greatest liberator of South America, who drafted their new constitution. Factional disputes and civil wars were many during the 19th century, and since 1827 Bolivia has had 70 presidents or dictators. Bolivia was the first South American nation to follow the lead of

the United States in protesting against Germany's submarine warfare during the World War of 1914-18. It severed diplomatic relations with Germany on April 13, 1917, after the torpedoing of the *Tubantia*, which had the Bolivian minister to Berlin on board.

BOLOGNA (*bo-lō'nyä*), ITALY. Few European cities present as vividly as Bologna the contrast between picturesque medieval days and the busy commercial life of modern times. Lying in a fertile plain at the base of the Apennines, it is the center of a network of railway lines which follow roughly the course of the ancient roads from Florence, Milan, Genoa, and Venice.

Along the arcaded streets laid out by the Romans in the 2d century B.C., busy shopkeepers ply a prosperous trade. Automobiles hurry up and down before the doors of the oldest university in Europe, the alma mater of Dante, Petrarch, and Tasso. In the shadow of the 130 churches, many of which date back to the 11th and 12th centuries, thriving factories turn out silk and linen, glass, leather, and machinery. The well-known Bologna sausages are sold in the markets where the Guelphs and Ghibellines fought for supremacy in the 13th century.

One of the most noted churches in the city is that of San Domenico, where lies the body of the founder of the Dominican order of monks. The excellent art collection of Bologna includes as its most highly prized work Raphael's famous painting of St. Cecilia.

The University of Bologna was founded in 1088 and its fame drew students from all parts of Europe. It began as a law school, but soon expanded to include faculties of arts and sciences, and in 1262 is said to have had 10,000 pupils on its rolls. It was here that Luigi Galvani discovered galvanic electricity in 1789.

Bologna was incorporated in the Papal States in 1506 by Pope Julius II. By a popular vote in 1860, it became part of the kingdom of Italy. Population, about 175,000.

BOL'SHEVISTS. The name Bolsheviks or "Bolsheviks" (*bōl-shē-vī-kē'*), which gained such wide currency in the years following the World War, comes from the Russian word *bolshinstvo*, which means "majority." It first arose in 1903, when the radical wing of the Russian Social Democratic party, led by Nikolai Lenin, gained a majority in a meeting to shape the policies of that organization, their opponents being called "Mensheviks" (party of the minority).

The Bolsheviks were extreme Socialists, who took literally the doctrine of a "class war" and sought to put the government exclusively in the hands of the "proletariat" (hired laborers). They gained control of the government in Russia in November 1917, in part through financial and other aid furnished by Germany, Russia's enemy. Gradually the Bolsheviks won over a considerable portion of the Mensheviks, and also of the Social Revolutionary party, to which most of the peasants belonged; for they encouraged the peasants to seize as their own the lands of the richer landholders.

Although the Bolsheviki made a shameful peace with Germany at Brest-Litovsk in March 1918, it was only with a view to substituting a people's war of revolution in all countries in place of what they styled an "imperialist" war of capitalist governments. After the close of the World War, they carried on active propaganda in many lands to bring on the "world revolution" which they sought, but outside of Russia their success was small. In Russia, however, by the use of methods as relentless as those which marked the former government of the Czars, they long succeeded in maintaining themselves in power against all attempts at counter-revolution. (See Lenin, Nikolai; Russia; Trotzky, Leon.)

BOMBAY (*bōm-bā'*), INDIA. The city of Bombay is "the gateway to India." Its harbor on the western coast of India is one of the finest natural shelters in the world and is only rivaled in beauty by the harbors of Naples, Rio Janeiro, and San Francisco. The city itself is on an island 11 miles long and 3 miles broad, but causeways and breakwaters connect the island with the mainland so that it is practically a peninsula. Along the coast-line to the southward a range of mountains, the Western Ghats ("stepping stones") look down on the city.

Bombay was a Portuguese settlement (1534), but came to the English in 1661 as part of the dowry of the Portuguese wife of Charles II. It is the capital of the Bombay Presidency, one of the largest administrative divisions of British India. The name comes from Bambai Mumba, a Hindu goddess.

The city is today the second largest in India, owing to its position on the European trade route to the East. The opening of the Suez Canal increased its prosperity and importance. It is the terminus of important railways, and its mills for cotton cloth, developed during the last half-century, have made Bombay a great manufacturing center.

Bombay boasts many of the finest buildings in India, both public and private, including the finest and largest hotel modeled on the American plan. The university is one of the oldest in India, and the city is a great educational center. Bombay is the headquarters of the British East India fleet, and to her docks come the largest ocean steamers from all parts of the world. In the bazaars are found representatives of not only every race in India but of every type of Asiatic and European.

The main European quarter is the old district known as the Fort, though there are many pleasant hilly sections overlooking the sea that are full of handsome modern villas. On one of these desirable sites, Malabar Hill, are the old Towers of Silence, where the Parsees deposit their dead to be devoured by vultures. The Parsees are descendants of a body of followers of the ancient Zoroastrian religion who fled from Persia to India about the 8th century because of Mohammedan persecution. Though they number less than 100,000, they are the richest and most influential group in the large native community,

many of their millionaires rivaling our own in wealth and public spirit. Population of the city, about 980,000.

BONAPARTE. What other household has numbered among its sons and daughters so many kings and queens as did the famous Corsican family of Bonaparte, whose Italian origin is shown by the original spelling of their name, "Buonaparte"?

The characteristics which made members of this family, in the early 19th century, rulers of a great part of Europe were probably inherited from their strong-willed mother. Her husband was a lazy, pleasure-loving, impractical man, who afforded her little aid in the rearing of their eight children, and who died in 1785. But she, according to her famous son Napoleon I (see Napoleon I), possessed "a man's head on a woman's body." She was endowed with good health, ceaseless energy, and a strong will, and these characteristics were manifested strikingly in the military genius of her second son. She lived to witness his glory and his fall, and even survived him by 16 years. But she never fitted into the altered family fortunes. Though given immense wealth and the title Madame Mère (Mother), she lived in such retirement and strict economy as to make her unpopular in France. Her last days were spent in Rome, whence she wrote a pathetic letter to the rulers of Europe begging for her son Napoleon's release from captivity. She died in 1836, after being almost blind for some years.

A Family of Kings and Queens

The eldest of her family, Joseph (1768-1844), was a man of culture and talent whose chief bent was towards literature. When he was made king of Naples by his brother Napoleon, Joseph introduced many much-needed reforms in that land. His troubles began when his imperious brother took the throne of Naples from him and gave him that of Spain. Joseph was unable to suppress the rebels of that kingdom, and was driven from his throne in 1813. After the battle of Waterloo, with the crash of the family fortunes, he found a place of refuge in America, and resided in Bordentown, N. J., for some time. He died in Florence, Italy, in 1844.

Unlike Joseph, who was exceedingly anxious for power, Napoleon's second brother, Lucien (1775-1840), was an ardent republican, took little interest in his brother's conquests, and often quarreled with him. He never ruled a kingdom, although he held from the pope the title of Prince of Canino. He died in Rome in 1840.

Next to Napoleon I, Louis Bonaparte (1778-1846) ranks in interest in this royal family. He was king of Holland by gift of his great brother, and was father of Napoleon III (see Napoleon III), second emperor of the French. When King Louis could not rule his country in the interests of its people he resigned his throne in 1810 and retired to Italy. A sentimental interest also attaches to Louis as the husband of Hortense, daughter of the Empress Josephine.

A kindly and sensitive nature, he was noted in his after-life for his philanthropy.

The youngest son of this illustrious family was Jerome (1784–1860), at one time king of Westphalia, a kingdom created by Napoleon in eastern Germany. Before attaining this royal dignity, Jerome had been in service in the French navy, and on one expedition had taken refuge from his English pursuers in the United States. While in this country he married Elizabeth Patterson of Baltimore, in spite of Napoleon's protests. The marriage was soon annulled by order of his imperial brother, and Jerome married a German princess; but from the first alliance sprang a prominent Baltimore family whose best-known member is Charles Joseph Bonaparte, secretary of war and later attorney-general of the United States in President Roosevelt's cabinet.

Napoleon's Sisters and What Became of Them

There were, besides the five boys, three girls in the family—Elisa, Marie Pauline, and Caroline—all of whom shared in their brother's glory. Caroline, who was married to Napoleon's general, Murat, even attained to the dignity of queen of Naples, for Murat was given that throne by Napoleon when Joseph Bonaparte was transferred to Spain. When her husband was shot, following the final fall of the Bonapartes, Caroline retired to Trieste, in Austrian territory, where she died in 1839. Elisa (1777–1820) married a Corsican who was made grand duke of Tuscany.

Pauline (1780–1825), the gayest and most beautiful of the girls of the family, was long a thorn in the flesh to her imperial brother. She was married to Prince Borghese in Italy, but when Napoleon was removed to Elba, in 1814, she and her mother joined him there. She is even said to have expressed a desire to share his exile to St. Helena, when Napoleon was sent to that remote island following the failure at Waterloo of his attempt to recover his lost power. She died of cancer in 1825. (*See also* Napoleon I; Napoleon III.)

BONDS. When a corporation or a government borrows money, it usually issues written or printed promises under seal to repay it at the end of a stated period, and to pay in the meantime a specified rate of interest per year. Such an evidence of debt is called a bond. (*See* Stocks and Bonds.) The word comes from the verb "to bind," and is used in other senses also—as "bail bonds" (security to appear for trial); "surety bonds" (given by officials who handle money as a guarantee of their honesty); "bonded warehouses" (government warehouse where imported goods or alcoholic liquors are placed pending payment of revenue taxes).

BONE. The hard tissue of which animal skeletons are made is called bone. It is heavier than water and varies from a grayish white to a pinkish color. It is composed of two classes of substances. One is the inorganic or mineral matter; this forms 65 to 70 per cent, with calcium and magnesium phosphate

predominating. These are the substances which give hardness to the bone. The other substances making up the bone are known as organic or animal substances. They form the remaining 30 to 35 per cent, and are in the form of ossein, proteids, and fats; it is these substances which give toughness to the bones.

Bones contain also a varying quantity of water—that is, a spongy bone has more water than one less porous, and the bones of a young person have more than those of old age. Arab children are said to make good bows from the ribs of camels.

If we burn a bone the animal substance is consumed and the mineral is left. It retains its original shape but is extremely frail and brittle. It is also white in color. If we put a bone in a weak solution

of hydrochloric acid, the mineral substance is dissolved out and we have left the animal. It also shows the original shape of the bone, but is very tough, soft, and flexible; indeed, a long bone so treated can be tied into a knot.

The entire bony system is pierced throughout by a rich network of extremely fine canals. These are filled with lymph, and hence the bone substance is constantly bathed in this life-giving fluid. Blood-vessels enter the bones to renew the lymph. Bone is alive and is kept alive just as the other organs are.

Bone marrow is the source of much blood-building material. It is pervaded by a network of connective tissue, in which are found the cells which make blood corpuscles, the red marrow developing the red corpuscles. This bone marrow is rich in proteids and fats, which makes it highly nutritious when eaten.

Bones grow in a peculiar manner. Cartilage or gristle first appears, a form of modified connective tissue; then the deposit of mineral substance begins, and the bone grows in girth by layers—somewhat like the successive rings under the bark of a tree—becoming harder and more brittle.

There are many commercial uses to which animal bones are put. From them we make buttons, knife handles, and the like; also bone ash, commercial fertilizers of several kinds, and bone black or animal charcoal. This last is made by removing the fats from the bone first—either by boiling or by a solvent;

THE RIGHT AND THE WRONG WAY OF SETTING BONES



A bone set like that on the right is not only easily broken again, but will make the limb crooked and shorter than the other one.

'PLOWING IN NIVERNAIS'



This, one of Rosa Bonheur's most famous paintings, depicts a familiar scene in Nivernais, a province nearly in the center of France where the peasants still employ oxen. Notice how the artist has brought out the slow but powerful movement of these great creatures.

then heating or charring the remainder with the air excluded. When ground, the bone black is used principally in sugar refining. If considerable meat and other animal refuse be left with the bones a variable product is made, known as bone tankage. This is extensively used in mixed fertilizers. (For the bones of the human body see Skeleton.)

BONHEUR (bŏn-ûr'), MARIE ROSALIE (1822-1899). What great artist had a private menagerie? Any schoolchild could guess, for all know the animal pictures of the Frenchwoman Rosa Bonheur, though all may not know that young lions followed her about like dogs and pined during her absence, or that wild chamois, goats, deer, gazelles, monkeys, and many

THE PYRENEES SHEPHERD AND HIS SHEEP



This painting by the great French animal artist is known as 'The Shepherd of the Pyrenees' and is one of the best examples of her work. A painter can study it for hours and constantly find new things to admire. Notice that although she was first of all a painter of animals, Mlle. Bonheur handled landscape with equal skill. An artist devoting his life to landscape could not have handled better those distant mountain peaks with their cloud mists and their snows, nor the dreary landscape of tumbled rocks and sparse vegetation in the foreground.

contained in the Easy Reference Fact-Index at the end of this work

other animals had their quarters in her country home at By, in the forest of Fontainebleau near Paris.

This painter studied her animals at first hand. Her father, a struggling artist of Paris and her only teacher, was so interested in the art of his children that, though their home was up five flights of stairs, he always provided some pet for Rosa and her sister and two brothers to sketch. They spent hours in art galleries copying pictures of the great artists, but Rosa liked best to catch the quick movements and changing expressions of living creatures. So, dressed in her brother's clothes, she went often to the stockyards of Paris; there with her short hair and strong features she easily passed as a boy and was freely admitted even to the slaughtering pens, where she studied the anatomy of the animals until she knew their bodily structure perfectly.

When only 18 years old her picture of two rabbits was accepted for the annual *salon*, or exhibition of French artists, in Paris. Five years later from the same institution she received a gold medal. When it was presented to her in the name of King Louis Philippe, the girl replied, "Thank the King for me and tell him I expect to do better." Four years later she ranked as the first animal painter of the day.

When 34 years old the income from her pictures enabled Mademoiselle Bonheur to establish a beautiful country home at By, where, except for occasional sketching trips, she spent the remainder of her life. Many medals and honors were bestowed upon her, and she was the first woman to be made an officer of the Legion of Honor.

Among the many paintings that have brought fame to Rosa Bonheur are 'Deer in the Forest', and 'Weaning the Calves', which, with the well-known 'Horse Fair', now hang in the Metropolitan Museum in New York City. The celebrated 'Horses Threshing Corn', showing ten life-sized horses, was at the time of its execution the largest animal picture ever painted.

BONIFACE, (*bŏn'ĭ-fās*), SAINT (680-754). While the good Pope Gregory the Great sat in Peter's chair at Rome, and Charles Martel, the "hammer" of the Moors, was mayor of the palace in the land of the Franks, the German worshipers of Woden and Thor were slowly being won to Christianity through the patient labors of a native of England whom we know as Saint Boniface. For nearly 40 years he labored in southern Germany—preaching, baptizing, consecrating churches, founding monasteries, and everywhere imposing better order on the clergy and establishing the authority of the Pope. He and his companion monks bore hardships without number, from fire and flood and famine in a savage land; and at last he crowned his life of heroic labor and sacrifice by suffering martyrdom at the hands of the heathen in what is now Holland.

Here is one interesting scene out of many in the life of this great missionary; the place is a gloomy forest in the heart of Germany, in which stood a sacred oak whose massive trunk and branches made it an object of wonder to every beholder. Under it

priests of Woden and Thor still performed their rites of heathen worship.

"Down with that tree," cried Boniface, "for it is an altar to false gods!"

But the pagans called down the curses of their deities upon anyone who should touch the tree, and no one dared to lift the ax against it.

Then said Boniface: "Behold, I will chop it down myself," and fearlessly he applied the ax. And when he had cut into the trunk only a little way, a breeze stirred overhead, and suddenly the wide branching top was broken off and the huge oak crashed to the ground in four pieces, while Boniface stood unharmed. The awed multitude accepted this as proof of the superiority of the Christian God, and agreed to forsake their heathen deities and to become Christians. Out of the wood of the fallen oak Boniface built a Christian chapel.

BONIFACE, POPES. The name Boniface was borne by nine different popes, beginning with BONIFACE I (530-532). BONIFACE VIII (1294-1303) was the most important of their number. In his pontificate occurred a bitter conflict with King Philip IV of France, in the course of which brutal agents of the king seized the aged Pope at his summer home in Anagni, and treated him with such indignity that he died about a month after his release. Shortly afterward Avignon on the River Rhone became, and for about 70 years remained, the seat of the popes—a period sometimes called the "Babylonian Captivity." BONIFACE IX (1389-1404) was one of the popes in the period of "the Great Schism," which followed the return of the papacy to Rome, while anti-popes still held forth at Avignon.

BONN, GERMANY. The ancient town of Bonn is situated on the left bank of the Rhine, about 15 miles southeast of Cologne. Known principally as the seat of one of the greatest German universities, it is also famous for the charm of its old buildings and the natural beauty of its scenery. Pleasant villas with pretty gardens reach down to the river, and its fine promenades and buildings, including a venerable cathedral, make the city a favorite residence for foreign visitors. By far the finest of the buildings is the former palace of the Electors of Cologne, which is now occupied by the university. Founded by King Frederick William III in 1818, the university prospered until it now ranks second to Berlin among Prussian institutions for higher learning. Prince Albert, the consort of Queen Victoria, studied at Bonn, which was a favorite place for the education of Prussian royalty. The University has five faculties—law, medicine, philosophy, and two of theology—an agricultural academy, and a splendid observatory. The city is also the birthplace of Beethoven, whose house is now used as a Beethoven museum. Although it owes its importance chiefly to its university, Bonn has various manufactures—principally of porcelain and stoneware—and carries on an active trade. Population, 88,000.

The WONDER of a PRINTED BOOK



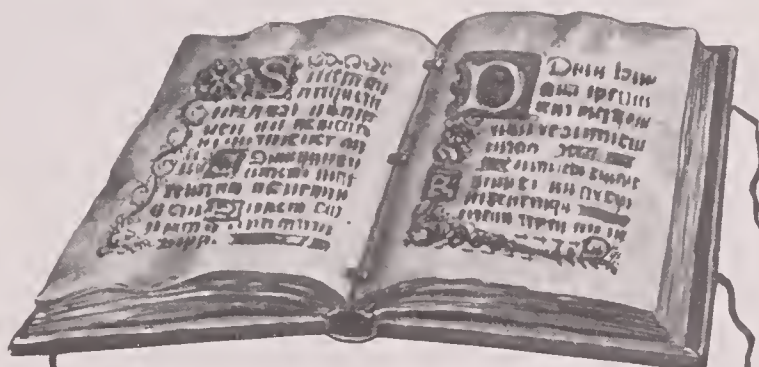
A GREAT poet, philosopher, or scientist dreams a dream or makes a discovery that is of interest to all mankind. By word of mouth he can carry his message to a few hundreds; with the aid of writing he may reach a few thousands; but by the wonder of modern printing his book can be multiplied by the millions of copies so that his message carries completely around the earth! "As good almost kill a man as kill a good book," said John

Milton. Here you may read the history of bookmaking, from the clay tablets, or papyrus or parchment rolls, to the present days of typesetting machines, photo-engraving, power printing presses, and all the elaborate machinery for binding the handsome books which we put in our libraries or carry in our pockets to read as leisure offers.

BOOKS AND BOOKMAKING. "Of making many books there is no end," said Solomon, and this is as true today as it was in Old Testament times. This is fortunate, for in these storehouses of ideas and information the best thoughts and the inspiring deeds of men of all times are given to us.

The printed and bound volume which we know today as a "book" is the result of centuries of development. The earliest records of man were chiseled on stone, wood, or other durable materials. The Babylonians impressed characters on soft clay tablets or bricks, and then baked them hard in square or cylindrical shapes. The laws of Solon were carved on wooden tablets and set up on the Acropolis in Athens; and the 12 tables of the old Roman law were similarly engraved on stone. Thin plates of ivory, bronze, or lead were also used for records of public value. These plates were often hinged in a form resembling a modern book. For brief notes both Greeks and Romans used small wooden tablets covered with wax, on which they wrote with a pointed "stylus." When the early Egyptians learned how to make a crude paper from the stem of the papyrus reed, they found a writing material of far greater convenience than any known before, and its use spread gradually through the Mediterranean world (see Paper). Its popularity was due not only to its cheapness, but also because its smooth, glossy surface made possible beautiful effects in lettering and ornamentation.

The common form of a book, when papyrus was used, was a roll or *volumen*, from which our word "volume" is derived. The papyrus was written on one side only, and was wound around a short stick, much in the manner of the maps we use today. Sometimes the strip was many feet long. Many



Wouldn't you like to own one of these old manuscript books, with its beautiful initial letters? This picture shows plainly how the vellum leaves were bound together with thongs.

of these papyrus rolls have been found in the coffins of mummies in the tombs of Egypt. The dry air of that country, together with the cedar oil in which the papyrus was steeped, has preserved them to such an extent that the writing is still clear and distinct. In reading such a roll the reader held it in his right hand

and unwound it, as he read, with his left, at the same time rolling up the read portion. The common practice in bookmaking establishments was to dictate the work in preparation to a great number of slaves (*librarii*), and each slave made one copy. This kept production costs low, and many book shops and public libraries existed in Rome in the days of the Empire.

The inconvenience of these long rolls and the perishable character of papyrus at length led to the substitution of parchment and the finer vellum (both made from sheepskin), cut in rectangular sheets and bound together at one side with thongs. This brings us, about the 4th century after Christ, to the form of our modern book.

But for a thousand years longer there were no books except those that had been laboriously transcribed by hand. All through the Middle Ages books

were made only by the monks in the monasteries, writing in what was called the "scriptorium." The lettering was often very beautiful, and the beginning of each part and sometimes the first words of each page were written in bright ink of various colors. Here and there might be great initial letters containing pictures in most brilliant colors. Such manuscripts were said to be "illuminated," and the colors in some of these old books are as vivid today as they were when they were written. When the volume was finished it was enclosed between massive covers of wood, over which leather was sometimes stretched. The covers of important works were often studded and banded with gold and silver and sometimes with precious stones, and were fastened with huge clasps. Most of the books of that time were copies of Greek and Latin classics and Bibles and church works written in Latin.

Don't Forget the Faithful Hands that Did This

At the end the copyist often added a note called a "colophon," telling when and by whom the copy was made. "He who does not know how to write," wrote a monk at the end of one manuscript, "imagines that it is no labor; but, though only three fingers hold

him who copied it. It was a poor brother named Louis, who while he copied the volume (which was brought from a foreign country) endured the cold, and was obliged to finish in the night what he could not write by day."



We owe the possession of nearly all the Greek and Latin classics we have to the patient labors of such monks as you see here. They did their work of copying with loving care, "illuminating" the manuscripts with brilliantly colored initial letters.



An early Christian scholar, seated in the great library in ancient Alexandria, is here reading from a scroll, unrolling it with one hand while he rolls it up with the other. Beside him is a leather case for carrying scrolls. Usually these scrolls had labels attached bearing the title of the volume.

the pen, the whole body grows weary." Another one added this note to his manuscript: "I pray you, good readers who may use this book, do not forget

In the 11th century, paper made from the pulp of linen rags began to find its way into Europe from the East. Its use increased rapidly after the invention of printing, for it was cheap and could be used easily on the presses.

Before the invention of printing from movable types, small religious books were sometimes printed from solid blocks of wood. These blocks of wood were the size of the page, and consisted mostly of pictures, with maybe a small amount of lettering engraved at the bottom. This method of printing is known as *xylography* as contrasted with *typography*, or printing from movable types. The first book printed from movable type is supposed to be the so-called "Mazarin" Bible, which appeared about 1453 (see Printing).

The Artist-Printers and Their Work

Early in the 16th century the books became smaller in size, thinner paper was used for the pages, and the wooden boards of the cover were replaced by paste-board. Artist-printers, like Aldus Manutius of Venice and Caxton in England, designed more beauti-



THE FIRST ENGLISH PRINTER AND HIS SHOP



In this beautiful painting the artist has shown us a memorable scene in the history of learning. William Caxton, the first English printer, is explaining to King Edward IV and his Queen the wonderful new process of making printed books which he had learned in Flanders. Caxton had set up a shop in the Almonry of Westminster Abbey in 1476, the year in which he issued his first book printed in England.

ful types and printed exquisite books, with elaborate coverings of vellum, silk, velvet, or other beautiful materials, sometimes of ivory set with precious stones. The most famous artists of the day made the illustrations, using not only woodcuts, but copper engravings, etchings, and (somewhat later) lithographs (see Engraving). The titles were usually very long, often covering an entire page. Gradually there came to be a wide variety of sizes, from the Thumb Bible, which is only a little larger than a postage stamp, to certain church books in Spain, which are described as six feet high and four feet broad.

At about the beginning of the 19th century, there was a conspicuous advance in the art of bookmaking. Better paper was used and the old hand printing press gave place to the steam cylinder press. But even these books seem poor and crude compared with those of today, with their wonderful illustrations by photoengraving—often in colors—combined with high quality paper and clear sturdy type.

As the art of bookmaking has advanced, so has the demand for books, until now the production and selling of books is one of the great American industries. The costs of publishing high-grade books is enormous.

It may be interesting, for instance, to know that the expense of preparing this one page alone for the press is greater than the selling price of an entire set of the books.

The book of today contains (besides the body of the book) a title-page giving the title, the name of the author, the publisher, and often the date of issue; a preface stating the plan and purpose of the book; a table of contents; and, if it is a volume of any size, an index.

Steps in the Making of a Book

What are the steps in making such a book?

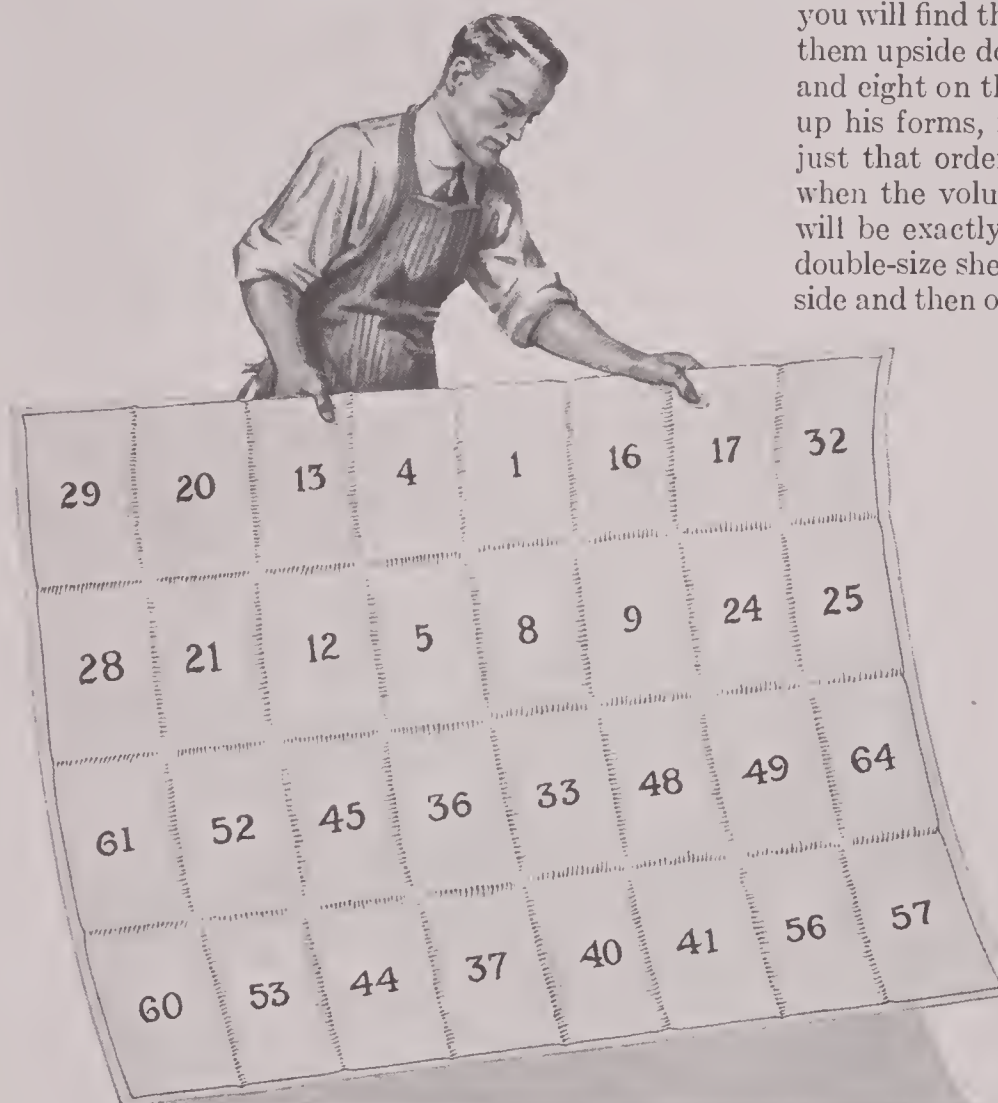
When a big printing establishment is planning to print a new publication, a "dummy" is first prepared, showing the paper to be used, the size of the page, the thickness, and binding of the volume. The "typesetting" is now



Some of the illuminated manuscripts of the Middle Ages not only had beautifully designed initial letters but were also adorned with illustrations in gold and brilliant colors. In the page reproduced here the Magi are shown adoring the Virgin and Child.

done almost entirely by monotype or linotype machines, and is not only more rapid and cheaper than hand composition, but it does away almost entirely with the old laborious process of "distributing" or returning the type to the "cases" after use (see Linotype; Monotype). After the "proof" is corrected by the printer and the author, the type is made up into pages and sent to the electrotyping rooms, where copper plates of each page are made (see Electrotyping). New proofs of these electrotyped plates are made and minutely scrutinized, so that any defects may be corrected. Then

EVEN SIXTY-FOUR PAGES ON A SHEET!



This diagram shows how the pages of a book are laid out for printing on a large sheet of paper. The pages whose numbers you do not see will be printed on the other side. When this sheet is printed on both sides and properly folded, all 64 pages will be in their proper order.

the plates are "locked up" in "forms" of 16, 32, or 64 pages each, and sent to the press room.

When paper was made by hand, the sheets were of standard sizes, so the number of times the sheet was folded to make the leaves of the book indicated the size. If it was folded once to make two leaves, or four pages, it was known as a *folio*; folded into four leaves, it was a *quarto*; into eight leaves, an *octavo*; into 12 leaves, a *duodecimo*, or 12mo. The folio books of course were the largest, and the 12mos came to be the usual size. When machine-made paper began to be manufactured, in almost any width and length,

these terms became misleading; so now the size of the book is usually expressed in the measurements in inches of the leaves.

How the Pages Get into Their Places

When you read a book, the pages follow along one after another in consecutive order, but that is not the way they were printed. Take a piece of paper, fold it evenly by bringing the ends together, then fold it crosswise, and again fold it in the same direction as at first. Now number the sheets of the folded paper as they would be if they were in a book, from 1 to 16. You now have a model of a 16-page section or "signature" of a book. When the sheet is unfolded, you will find the numbers are widely scattered, half of them upside down, and eight on one side of the paper and eight on the other. The printer, when he makes up his forms, must have the plates for the pages in just that order, and they must be arranged so that when the volume is bound, the top lines of printing will be exactly even throughout the book. Often a double-size sheet is used, which is printed first on one side and then on the other with the same 16 pages and then cut in the middle.

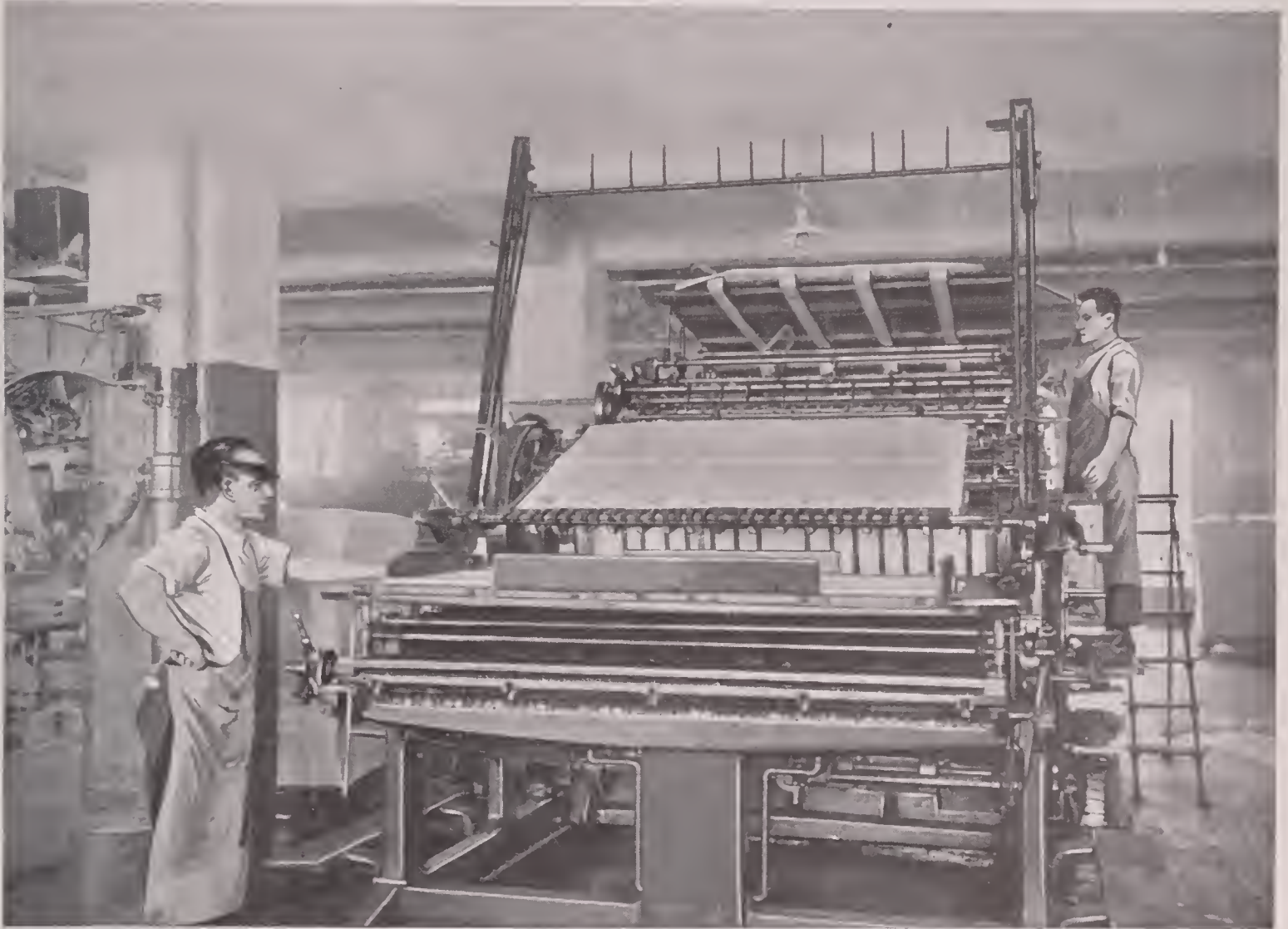
The covers of books today are usually stiffened with tar-board (called binder's board) and are covered with leather, binder's cloth, or cover paper. When no binder's board is used, the binding is known as "limp." A "full leather" binding is one in which the back and the sides are entirely covered with leather; a "half-binding" has leather on the back and the remainder is of cloth; a "three-quarters" binding has a leather back and pieces of leather at the corners. In some European countries, it is customary to publish most books in paper covers. The purchaser, if he cares to keep the book in his library, can then have it bound to suit his taste.

Some of the hand-bound leather bindings are handsomely decorated in gold leaf with elaborate tooling. This work requires an artistic taste of the highest order, and the book-binder engaged on such work must

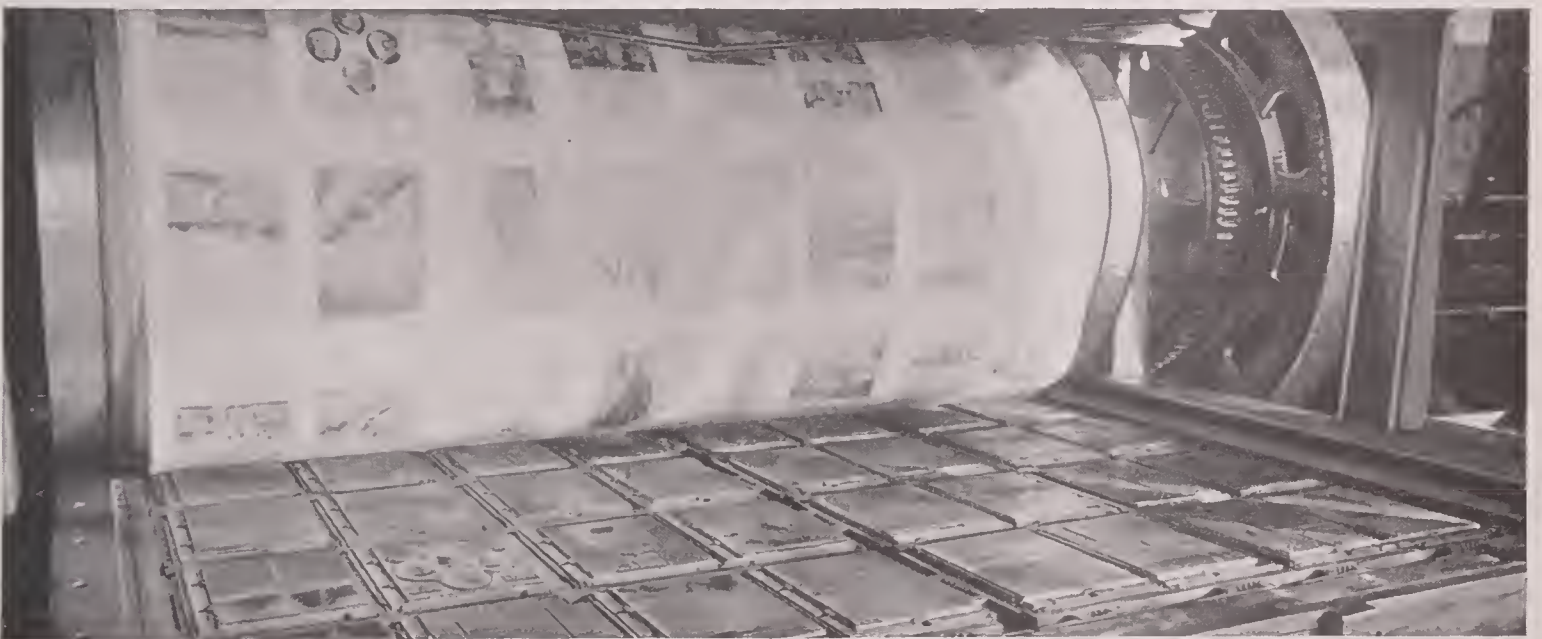
be an artist and craftsman of great ability.

What a blessing low-priced books are, and how much we may congratulate ourselves that we live in the present age rather than in the days when books were only the luxuries of the rich! In part this cheapening of price is due to the invention of such machines as the linotype and monotype; but in even larger part it is due to the development of the modern printing press, to electrotyping, to less costly paper, and to the many machines used in the great book-binding establishments which turn out our popular books by the tens of thousands.

HOW A BOOK LIKE THIS ONE IS PRINTED

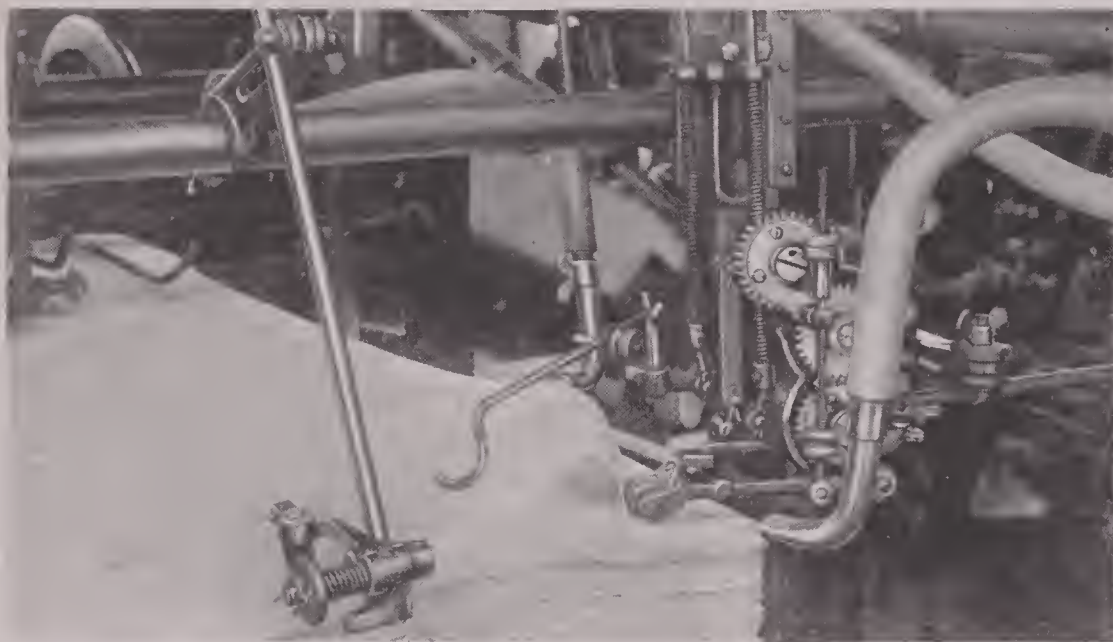


STARTING ON THE JOURNEY THROUGH THE PRESS.—At the very top you see the edge of a big blank sheet of paper ready to start on its journey into the wonderful land of printed speech. From this automatic "feeder" the sheet passes down behind and is wrapped around a cylinder under which rolls the bed carrying the inky type "form." This puts the printing on the sheet. Then a set of long steel fingers scoop the sheet off the roller, holding it flat as you see in the middle of this picture. Then, with a sweep, the printed sheet is piled face down on the table on which the man at the left is resting his hand.

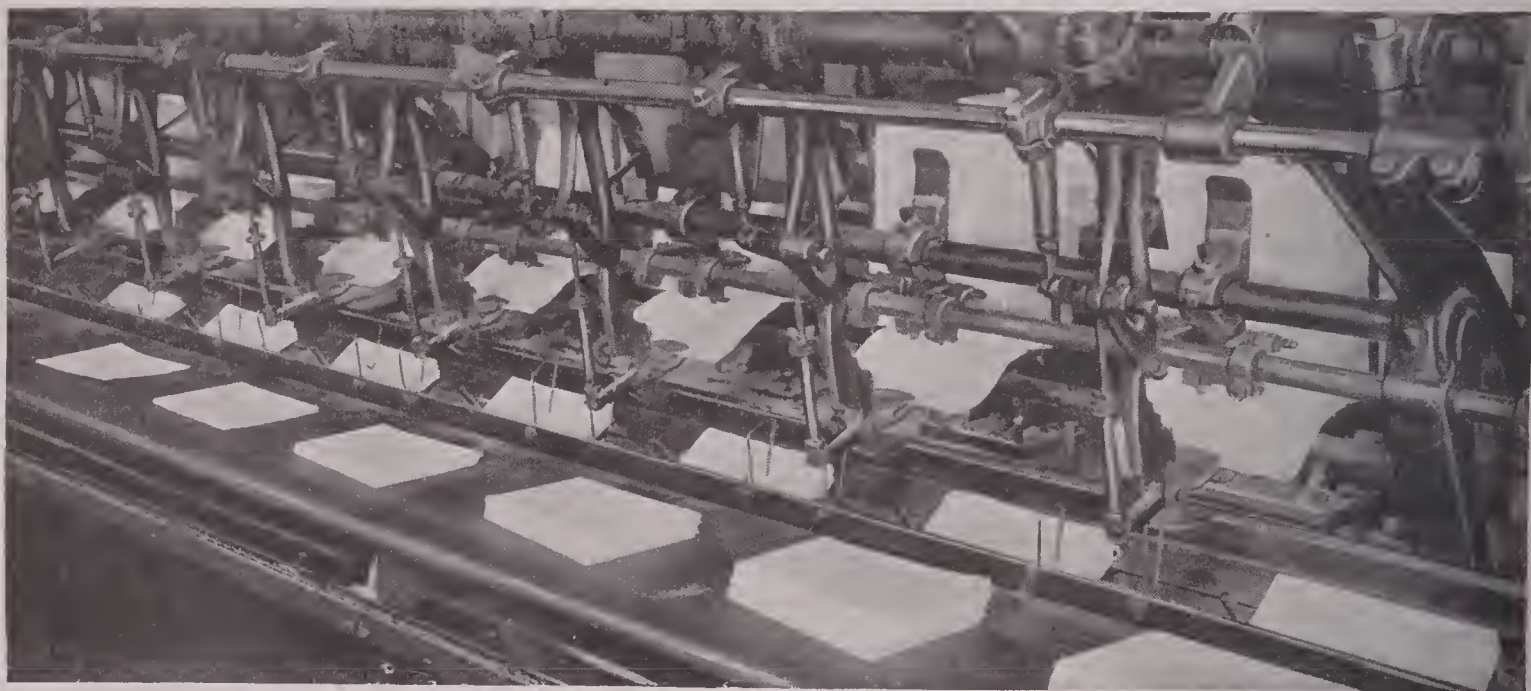


THE PRINTING OF THE PAGES.—Here we see the cylinder and the type "form" mentioned above. Each one of the small oblong divisions of the form is a plate to print a page of the book—32 are being printed at once. The whole bed of the press on which the form rests moves backward and forward. When it moves back the printing cylinder is raised up and the type passes on to the inking rollers—these small black rollers of elastic composition shown beneath the table in the first picture. As the form sweeps under them the ink is spread with exquisite evenness over the surface of the form. Meanwhile the big cylinder holding a fresh sheet of paper has dropped down again and presses against the form as it comes forward, printing from the inked form all those tiny letters and those picture patterns. This photograph shows us the press at the end of one of these return trips, just after the sheet has been printed.

contained in the Easy Reference Fact-Index at the end of this work



THE MECHANICAL THUMB THAT LIFTS THE SHEETS.—Of all the brainy things machinery does in the making of a book, one of the most remarkable is the work of the feeder of the folding machine, shown here. Just as you sometimes start turning a book page with the moistened thumb, that roller finger pushes up one sheet at a time, while that hooked rod in front holds the pile firm. Then the tube at the right blows a jet of air under the sheet and loosens it from the rest so that it slides quickly through the folding machine where the entire 32 pages are folded into two separate sections, ready for the "gathering" machine. But the strangest thing is yet to be told. If that little roller-thumb should happen to pick up two sheets, what do you suppose it does? It stops and won't do another thing until you come and straighten matters out!



THE GATHERING AND THE SEWING.—When each of the great sheets has been folded, it forms what is called a "signature" or section, containing 32 pages of the book. All the different signatures are piled in separate stacks at the back of the "gathering" machine you see here. This machine has been "trained," so to speak, to pick up the successive signatures of the book in their proper order. It seems difficult, doesn't it? But it's really very simple. Those clasp-fingers take a signature from each of the stacks at the back and lay them on the long table in front. But that table moves, carrying the piles forward a space at a time, so that signature No. 2 falls on signature No. 1, signature No. 3 on signature No. 2, and so on, until at the end of its trip each pile is made up of one copy of all the signatures in the volume. These piles now go to the sewing machine.

In the sewing process, the signatures are picked up one by one by the girl at the left and set astride carrier arms which feed them into the machine. There five needles work at once, stitching the signatures through the middle and also sewing them together in a continuous row. As they come out on the other side of the machine, the girl at the right cuts them apart into volumes. Skill and care are required in this work, for a single signature out of place means a spoiled volume.



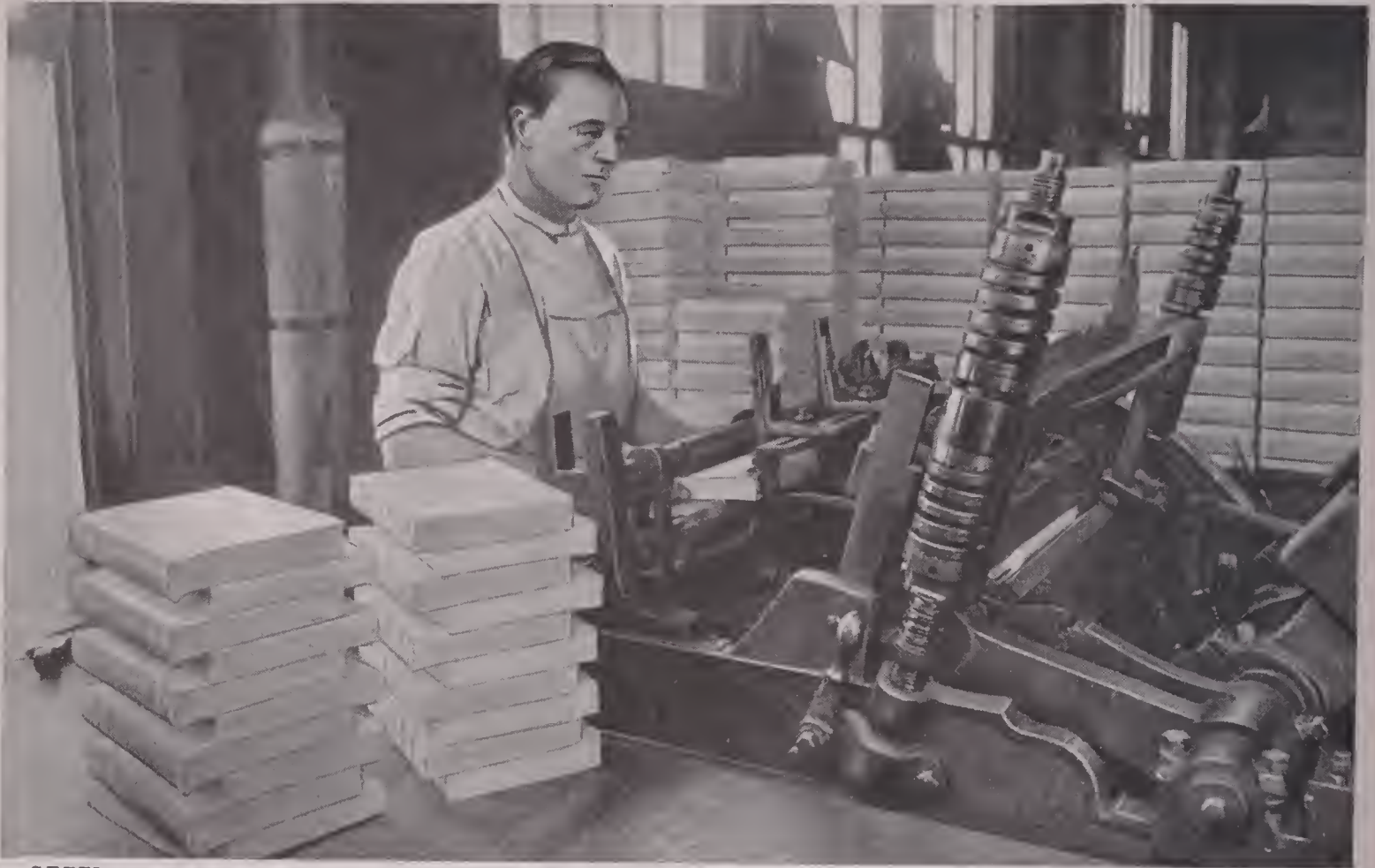


PRESSING AND TRIMMING.—The volumes now go into the powerful binder's press, shown on the left, which squeezes all the air from between the pages. Notice how much thinner this makes them! Then the volumes pass under the powerful trimming machine at the right, where sharp knives come down and cut off the rough edges of the paper and trim away the outside folds of the signatures. The edges of this book show how neatly these knives do their work. Sometimes, for the sake of artistic appearance, the edges of a book are left rough. Then you have to cut the folds yourself with a paper cutter.



"MARBLING" THE EDGES.—Here you see how the marbling is put on the edges of books. This tank is filled with a sticky liquid. The workman uses brushes dipped in fluids of different colors, and spatters the surface of this liquid with each color separately, one on top of the other, thus forming a marbled pattern. Then he dips in the edges of the book, which pick up that pattern. Against the wall you see two piles of unbound books, one of which has been marbled.

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GETTING READY FOR THE BINDING.—Here the volume begins to take its bound form. Notice how nicely the front of this book curves inward and the back curves outward. This is done in the rounding press which this man is operating. A steel bar with a rounding groove presses against the back and a powerful clamp pinches the volume permanently into this position. This gives the book what is called a "spring back," which helps it to hold its compact shape.



STAMPING THE LETTERS OF GOLD.—At the left you can see the covers or "cases" made from binders' board and binding cloth, with flat sheets of gold leaf in place for stamping. Each cover now goes under the hot stamping press here shown. The stamp is a brass plate engraved with the cover design. It is heated and then, coming down, presses the lettering and the design into the cover. The cover in the center has just been stamped. After the stamping, the operator rubs over the design with a spongy eraser, which removes all of gold leaf except that stamped in by the brass plate.



AT LAST THE BOOK IS UNDER COVER!—At last those wonderful talking pages and pictures of our book are ready to go inside the "case" or cover, which will protect them so well that they may outlast many human lives and go on telling their story to the grandchildren of the original owner! We saw on the preceding page how the "spring back" was first shaped. The next step was to fasten upon the back with a heavy coat of glue a strip of that coarse-woven cloth called "buckram," and to paste over

the middle of that strip a narrow sheet of cardboard, leaving a flap of buckram projecting on each side. This completes the "spring back." Now comes the job of gluing on the cover. Now the volume comes to the machine shown above, which has three revolving plates. The two buckram flaps, which will be the hinges on which the cover swings, and the two end sheets of the volume are covered with glue. Then the volume is placed astride one of the plates, as you see here. This plate moves automatically a certain distance to the right, where it is seized and thrust down. A cover from that stack at the rear slides into place, and is clamped tight against the sticky flaps and end sheets. Then the plate moves around to the operator, who is just in the act of removing a volume. If you will examine carefully the back of this book and the joints of the cover, you will see how simply and yet how effectively these various parts do their work. Notice particularly how they give a "spring" to the cover and the pages.

The covers having been added, the books are put under presses to dry—rows and rows of them at a time—so that the covers will be nice and straight and fit the book perfectly. There are boards between the books in the presses and they have brass ridges which indent those creases into the covers and so make those gates into the wonderland of knowledge swing nicely on their hinges. The books remain in the press from 6 to 24 hours so that the glue will be perfectly dry and the pages will get used to their new clothes. Then they go out into the world to start their life's work—teaching, entertaining, being companions to all who care to seek their friendship.



BOOMERANG. The most remarkable weapon invented by primitive man was the boomerang, used by the natives of Australia. It is made of hard wood bent into a curve over a bed of hot coals. It is from two to four feet long, flat on one side and rounded on the other, with a sharp edge. There are several kinds of boomerang—for war, for hunting, and for amusement—varying in size and proportion. The well-known “return” boomerang is chiefly used as a toy. Instead of going straight forward, it slowly rises in the air, whirling around and around in a curved line until it reaches quite a height, when it begins to fly back again and sweeping over the head of the thrower falls behind him. This surprising motion is produced by the action of the air on the bulging side of the boomerang. The other types are effective weapons because of their size and irregular motion, but they do not return to the thrower. The natives show remarkable skill in the use of this weapon; it is said that with it they can almost cut a small animal in two at ranges within 400 feet.

BOONE, DANIEL (1734–1820). The mighty hunter Daniel Boone tells us that “it was on the first of May in the year 1769 that I resigned my domestic happiness for a time, and left my family and peaceable habitation on the Yadkin River, in North Carolina, to wander through the wilderness of America, in quest of the country of Kentucke.”

When only a boy he had come with his father from his native state of Pennsylvania to their home on the Yadkin, on the frontier of North Carolina. Pioneer life suited the lad, and he early developed a passion for hunting and exploring. As early as 1760 he had begun his explorations and pushed his way as far as Boone's Creek in eastern Tennessee. Near this stream there still stands a tree bearing this quaint inscription: “D. Boon cilled a bar on (this) tree in the year 1760.”

Fired by the glowing description of his friend John Finley, who in 1767 had penetrated into the border regions of Kentucky, Boone and five companions set out to explore that country. He was absent from home for two years, during which time he was once captured by the Indians, his only companion was killed by them, and he lived for two months alone in the wilderness without bread, sugar, or salt.

When he returned home, Boone was anxious to move his family to Kentucky, which to him seemed a second paradise. He had become dissatisfied with life in North Carolina which was becoming too thickly settled to suit his wild nature, while Kentucky was a vast wilderness peopled only by the Indians. The fact that it was a “dark and bloody ground,” even to the red man, did not worry Boone, for he was entirely unacquainted with fear. He had learned the ways of the Indian, not only from his frontier experiences, but also when he accompanied Braddock on his disastrous expedition in 1755.

Boone's enthusiasm over Kentucky was contagious. Because he had confidence in himself he

was able to inspire it in others, and he persuaded five other families besides his own to move west. At Cumberland Gap they were attacked by the Indians and six of their party were slain. Two years later, in 1775, they succeeded in reaching their destination, on the Kentucky River, and established Boonesborough.

During the Revolutionary War Boone rendered valuable aid to the settlements of Kentucky by his courage in repelling Indian attacks. At one time he was captured and carried to the English post at Detroit where he was adopted into the Shawnee tribe. When he learned that an attack on Boonesborough was being planned, he escaped, traveled 160 miles in four days, and bore a conspicuous part in defeating the Indians.

Boone always had a great contempt for law and lawyers, and as a result he neglected to secure the legal right to his land. This led to the loss of all of his possessions when the state of Kentucky was formed. Disgusted with a country which so poorly repaid his services, he crossed the Mississippi River and settled in Spanish territory 45 miles west of St. Louis, in 1795. When this region likewise came into the possession of the United States, through the Louisiana Purchase, Boone was again dispossessed of vast estates, owing to the fact that he had not taken the trouble to go to New Orleans to get his title confirmed by the representative of Spain. His lands in Missouri were later returned to him by Congress, because he had “opened the way for millions of his fellow men.” There he died, in his 87th year, surrounded by his children and their descendants—some of them in the fifth generation.

Boone has come to be regarded as the typical pioneer—fearless, skilled in woodcraft and the use of weapons, yet quiet and mild-mannered. Many fiction stories have been based upon his exploits.

BORAX. Nine-tenths of the borax produced in the United States comes from the famous Death Valley, in the desert part of southeastern California. That region is several hundred feet below sea-level, and contains enormous deposits of this and other salts, left by the drying up of bygone lakes. Nevada also produces quantities of this useful chemical. Until recently, however, the salt lakes of Tibet were the chief source of supply, although some borax was also obtained from Persia, Chile, and Peru.

Chemically, borax is a compound of sodium (or soda) with boric acid. It is soluble in water and has a slight alkaline taste. It is put to a variety of industrial uses, especially as a flux in aiding the fusion of metallic mixtures, and in welding iron, soldering metals, and other brazing operations, as well as in making enamels and in fixing the colors on porcelain. It is also used as a food preservative. Its power of dissolving grease makes it a useful cleansing agent. In combination with glycerine it is also used as a disinfectant and antiseptic for sore throats and in the treatment of thrush in children's mouths.

WHAT AN AUSTRALIAN CAN DO WITH A BOOMERANG



The Australian "black fellow" can make his boomerang do all these things. In No. 1, he shoots it ahead of him so that it strikes the ground, makes two loops and then one grand loop through the air back to his feet. In No. 2, it sails through the air and comes back again without touching the ground. In Nos. 3, 4, and 5, it is executing various other air maneuvers more complicated than those of the bird-man. No. 6 shows how a boomerang with a hook at the end can be made to catch on the shield of an opposing warrior and hop right over at him. In No. 7, the native concealed from view is "shooting" a duck. Figures 11, 12, and 13 show how boomerangs of different shapes are cut out of trees.

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BORDEAUX (*bôr-dô'*), FRANCE. Thousands of Americans who crossed the Atlantic during the World War of 1914-18 will remember the port of Bordeaux, up the wide Gironde River on the west coast of France, as a place of tremendous activity, surrounded by great secrecy. They will recall how the ship, with lights darkened and escorted by swift destroyers, passed through the dreaded "submarine zone," and came upon a shore whose name they did not even know; how it entered what seemed like a great bay, and how, after sailing 60 odd miles southeastward, to where the Gironde becomes the Garonne River, they arrived at their port of disembarkation "somewhere in France."

They will remember the long lines of newly built docks, the vast warehouses, the cold storage plants, the extensive railroad yards, where English was spoken and the American uniform held sway. For Bordeaux was the main sea-gate of the American services of supply ("S.O.S.") which fed, clothed, and equipped the United States soldiers fighting in France. The giant wireless station—the most powerful in the world—begun by the Americans has been taken over and completed by the French government.

Bordeaux today retains many of the railway and harbor improvements built by American army engineers, and these advantages bid fair to make it the leading seaport of France. The historic city has always been a great trade center, famous for its wines. The harbor is divided by the Pont de Bordeaux, a noble bridge of 17 great arches, one of the most famous in the world. The city, crowded along the left bank of the Garonne, boasts many fine old buildings, notably the Cathedral of St. André, dating from the 11th century, the Grand Théâtre, and the church of St. Michel, whose bell tower, 354 feet high, is the largest in the south of France. Bordeaux is also an important educational center and contains a library with more than 200,000 volumes.

The whole city is surrounded by a semicircle of boulevards, beyond which lie the beautiful suburbs, spread out on vine-clad hills.

The chief steamship line using this port carries on a valuable trade with South America. Besides wine, the chief exports are hides and skins, sugar, rice, cotton and woolen cloths, salt fish, fruit, and vegetables. A large fleet of fishing boats is sent each year to the Banks of Newfoundland and Iceland.

Bordeaux was a flourishing commercial city under the Romans. From 1154 to 1453 it belonged, along with all the surrounding country, to the English kings. In the 14th century the Black Prince held his court here. During the French Revolution it was the headquarters of the Girondists, and as such suffered greatly during the Reign of Terror.

The government of France was twice transferred from Paris to Bordeaux—once during the Franco-Prussian War, and once in the early part of the World War, when the German armies threatened Paris. Population, about 265,000.

BORDEN, SIR ROBERT (1854-). The Right Hon. Sir Robert Laird Borden, prime minister of Canada from 1911 to 1920, was born in the historic village of Grand Pré, Nova Scotia, on June 26, 1854, of a family which had been in Nova Scotia since 1760. After an education in the schools of his native province, he became a barrister; and he rose rapidly to a place of great prominence in the legal profession of Nova Scotia.

As with so many others in Canada, law proved with him a stepping-stone to politics. In the general elections of 1896 he was elected a member of the Dominion House of Commons for Halifax—a constituency which, with but one intermission, he continued to represent. During the years 1896 to 1911 the Conservative party, of which he was a member, was in opposition. His great ability, nevertheless, impressed itself on the country; and in 1901 he was chosen leader of his party in the House of Commons. For ten years he fought an uphill fight against heavy odds; then in 1911 he reaped his reward when the Conservative party swept the country in opposition to a trade reciprocity agreement with the United States. On the resignation of Sir Wilfrid Laurier, the Liberal leader, Mr. Borden was asked to form a cabinet; and he thus entered on a prime ministership which coincided with perhaps the most critical and glorious period in Canadian history.

During his first few years as prime minister, Sir Robert Borden (he was knighted in 1914) was much hampered by the opposition of the Liberal majority in the Canadian Senate; but as soon as the outbreak of the World War brought a truce to party strife, he got a chance to show the quality of his statesmanship. On the declaration of war he offered to the mother country Canada's whole-hearted support; and his guidance of Canada's destinies during the difficult but heroic years that followed entitles him to a very high place in the honor roll of the British Empire. Starting with an expeditionary force of 33,000 men, he did not stop until he had placed before the Canadian people the goal of 500,000 men as Canada's contribution to the struggle. When the need for men grew acute, he asked parliament to adopt the principle of compulsory military service; and in order to carry this measure in the country, he formed a coalition with the "conscriptionist" wing of the Liberal party. The general elections of 1917 amply justified his policy; and he was thus enabled to carry forward Canada's part in the war to a successful conclusion. The high reputation which the Canadian troops achieved in France and Flanders was due in part, at least, to the courage and wisdom shown by Sir Robert Borden. It is a fact of some significance that, among the prime ministers of all the Allied nations, Sir Robert Borden was the only one who directed the affairs of his country from first to last.

In 1917-19 Sir Robert Borden was a member of the Imperial War Cabinet, composed of five ministers of

the United Kingdom and the prime ministers of the self-governing dominions. Previously to this he had sat in the Imperial Cabinet, July 1915, the first occasion on which an overseas minister has ever participated in the deliberations of the Imperial Cabinet.

On the conclusion of the war, Sir Robert Borden went to Paris as the chief representative of Canada at the Peace Conference; and here he was mainly instrumental in obtaining for Canada and the other self-governing dominions of the British Empire due recognition as members of the League of Nations. By this time, however, the strain of his labors during the war and at the Peace Conference had told upon his health; and shortly after his return to Canada, he was obliged, for this reason, to relinquish the duties of prime minister. In the summer of 1920 he resigned and retired to private life, handing over the reigns of power to one of his lieutenants, Mr. Arthur Meighen.

Temperamentally Sir Robert Borden was not inclined to lend himself to the minor arts of the politician; but his achievement in accomplishing the formation of the Union Government in 1917, in the face of strong opposition within his own party and upon the basis of according equal representation therein to one wing only of the Liberal party, required remarkable gifts of patience, perseverance and firmness of purpose. He did not possess the oratorical gifts of Sir Wilfrid Laurier, and his speeches upon the public platform were characterized by earnestness of appeal to reason rather than by eloquence. Throughout the war he acted with great promptitude and vigor as occasion demanded.

Not many statesmen have made fewer mistakes than he made. With his scrupulous honesty, his conscientious caution, and his sound judgment, he gave Canada during the years of the World War an administration of well-balanced statesmanship.

BORGIA (*bôr'jā*) **FAMILY.** Of all the princely houses of Renaissance Italy, none was more powerful between 1455 and 1504 than this family of Spanish origin, which gave two popes to Rome (Calixtus III, 1455-1458, and Alexander VI, 1492-1503), and which in Caesar Borgia (1476-1527) supplied the perfect

type of the coldly calculating, unscrupulously wicked Italian tyrant.

Alexander VI frankly used his office to build up the power and fortunes of his children, whom he openly acknowledged. Trickery, war, poison, and the

dagger were freely used to advance the family interests, though historians now disbelieve most of the tales of subtle and secret poisonings attributed to Alexander and his son Caesar as beyond the chemical knowledge of that time. The almost royal power of Caesar Borgia practically ended when his father was fatally stricken at a banquet in 1503, and he himself was temporarily incapacitated by a mysterious illness, which their contemporaries attributed to poison which they had placed for their enemies.

Caesar's sister, Lucretia Borgia (1480-1519), was represented by later writers as a veritable monster of wickedness. But she is now believed to have been "more sinned against than sinning," and a mere tool in

the hands of her unscrupulous family. In her later life as duchess of Ferrara she showed herself a woman of beauty, grace, and gentle manners, as well as a beloved patron of artists and scholars.

St. Francis of Borgia (1510-1572), a later member of the Spanish branch of the family, attained fame of quite a different sort as the pious and able head of the Jesuit Order.

BORNEO. If you visit the Dyaks, one of the primitive peoples who live along the jungle rivers of the island of Borneo, in the Malay Archipelago, you will have to sleep in a huge barnlike structure built above the ground on high stilts, with a great cluster of smoke-blackened human skulls grinning down at you from the rafters. For the Dyaks think they are honoring a visitor by lodging him in this "head house," where they keep the heads they have triumphantly cut from the bodies of their slain enemies.

"Wild Men of Borneo" Still Pretty Wild

Although the Dyaks, the former "wild men of Borneo," are today peaceable farmers for the most part, they still occasionally go head hunting, and they are still ghost-worshipping semi-savages. Over their queerly tattooed brown skins they wear only the scantiest of coverings, for the climate is warm

CANADA'S WAR PREMIER



Sir Robert Borden won international distinction as Canada's Premier during the World War, and as chief representative of the Dominion at the Peace Conference. Throughout those troubled days he was conspicuous for far-sighted ability and energy.

and exceedingly rainy the year round. Their teeth are always stained dark red from much chewing of betel nut. They count on their fingers and toes, and if the total exceeds 20 they may have to call in their neighbors to assemble more fingers and toes.

These primitive people live in the third largest island in the world, for Borneo is exceeded in size only by Greenland and New Guinea. Though the entire population is only about a third that of the city of New York, yet its area is 290,000 square miles—nearly as large as that of the three Pacific states, California, Oregon, and Washington.

If you should gaze down upon this vast island from a flying machine, you would see it all as one great emerald patch of jungle, with ridges of forest-clad mountains traversing it irregularly. Threaded through the mysterious forests—which are still largely unexplored—you would see many silvery rivers with small trade steamers and fishing canoes on them.

If you descend, you find few familiar trees in these gloomy woods, forever dark and damp. Here grow ironwood, teakwood, ebony, and other valuable woods, which form the country's chief natural resource, intermingled with camphor trees, fan palms, coconut palms, and many delicate ferns.

The "Zoo" in the Jungles

Through these tangled jungles stalk the wild Malay ox, the tusked pig, and the honey bear. The rhinoceros and the elephant feel their clumsy way over fallen tree trunks; and the orang-utan—that powerful, human-looking ape called by the natives the "jungle man"—swings by his hairy arms from branch to branch. Through the lofty tree tops at night dart the flying fox and the flying frog.

For more than half a century a large part of this amazing land has been under the absolute rule of a white man. This district is Sarawak, a territory as large as Wisconsin. Sir James Brooke, an Englishman, in 1840 assisted the Sultan of Brunei in putting down a revolt, and in return was made governor and rajah of Sarawak. The title is hereditary and has been since held by Rajah James Brooke's nephew and grand-nephew, under British protectorate.

Great Britain also exercises a protectorate over the districts known as Brunei and British North Borneo. The latter is governed by a British company. By far the largest and most valuable part of the island belongs to Holland. Borneo has rich deposits of coal, iron, gold, diamonds, silver, platinum, tin, mercury, petroleum, rock salt, marble, and porcelain clay. It produces in profusion spices, nuts, sago, camphor, gutta-percha, and numerous tropical fruits, such as pineapples and bananas. Sugar cane, coffee, cotton, rice, and tobacco are cultivated along the coast and the rivers. Large plantations of rubber trees have been started, and the rubber produced now amounts to about one-half of the country's entire export trade. The Dyaks, the aboriginal inhabitants, form the great majority of the population. There are also large numbers of Malays, who dwell along the coast and are traders and sailors. The third important group is the Chinese, who engage in trade and mining. Population, about 1,850,000.

BOS'NIA AND HERZEGOVINA. In Serajevo, the capital of the Austrian province of Bosnia, was fired the first shot of the World War of 1914-18—the shot that snuffed out the lives of the Austrian archduke Franz Ferdinand and his wife, and gave Austria an

opportunity to seek to extend her sway from Bosnia and Herzegovina over the whole of Serbia.

These two provinces lie in the extreme northwestern portion of the Balkan Peninsula, and like their neighbors to the south they have experienced a stormy career. Although the two cover less than 20,000 square miles—about twice the size of Vermont—they have been coveted by many nations. During the days when Rome ruled the world, they were a part of that vast empire; but after the barbarian invasions they belonged at one time to Hungary, at another to the Serbs, and again they were independent. In the 15th century with the rest of the Balkans they fell under the power of the Turks, and there they remained until 1877. In that year, with the aid of Russia in the Russo-Turkish War, they gained the right of self-government from Turkey. But at that point the Great Powers of Europe interfered, and by the Treaty of Berlin (1878), Bosnia and Herzegovina were handed over to Austria, to "occupy" them and so keep order. "Occupation" became ownership in 1908, when Austria calmly annexed the two provinces to her own territory, and kept them until the World War once more gave them their freedom. Then they merged their fortunes with the new state, Jugo-Slavia. (See Jugo-Slavia.)

Oppressed as they have been under the heel of successive foreign powers, the people of these provinces have made little progress in industry. Their main occupations are agriculture, mining, and forestry, and their chief exports are wheat, hay, potatoes, prunes, raisins, iron, and timber.

The people of Bosnia and Herzegovina in official Austrian documents were called "Bosniaks," but they themselves refused to use the name. A third of the 2,000,000 inhabitants were followers of Mohammed and called themselves Turks. The members of the Roman Catholic Church chose the name of Latins, while the adherents of the Greek Church were designated as Serbs. The existence of such racial and religious differences is one of the many difficulties in the creation of the new Jugo-Slav state.

BOSPORUS. The beautiful river-like strait of the Bosphorus (or Bosphorus) is hardly less famed than the world-famous city of Constantinople, which commands its southern entrance. It lies between the Black Sea and the Sea of Marmora, and forms part of the dividing line between Europe and Asia Minor. For a distance of 11 miles the channel of the Bosphorus, from one-third of a mile to two miles broad, winds in and out through a picturesque landscape dotted with cypresses, laurels, and ancient plane-trees, while the shores themselves are lined with towns and villages, antique towers and modern forts, and lovely palaces and summer homes of wealthy Constantinople residents. The Golden Horn, an inlet on the European side, forms the harbor of Constantinople.

The word "Bosphorus" comes from the Greek and means "ox-ford," suggested by the legend that the goddess Io swam across the strait in the form of a cow.

HISTORIC BOSTON

New England's Metropolis



BOSTON, MASS.

Oliver Wendell Holmes, one of Boston's wittiest sons, once said: "Boston State House is the hub of the Solar System; you couldn't pry that out of a Boston man if you had the tire of all creation straightened out for a crowbar." Perhaps the Bostonian of today no longer believes that the hub of the universe visibly projects at the peak of Beacon Hill; but he has a pride in his native city, in its

brave and romantic past, in its culture and literary traditions, in its splendid and prosperous present, which finds an echo in the hearts of all Americans. For here trod the Puritan fathers, John Winthrop and Cotton Mather; in Boston halls resounded the patriotic oratory of James Otis, the Adamses, and other Revolutionary leaders; and on every hand are memorials of Boston's notable part in America's history. So this fine and mellow old city, where the memories of three centuries survive undimmed in the midst of 20th century bustle and din, is a precious heritage to the whole nation.

The great gilded dome of the Massachusetts State House, like a ball of fire hung high in the air, is the most conspicuous object which meets the visitor's eyes, whether he approaches Boston by land or by sea. Ascend to the cupola which crowns the dome, and you will behold a scene never to be forgotten.

THE anxious mariner off the rock-bound New England coast who detects through the night the flashing signal - - - - - ("1-4-3") breathes a sigh of relief, for he knows that before him is Minot's Ledge lighthouse, and he has his bearings for the entrance to Boston harbor. Every 16 seconds this famous lighthouse sends forth to sea its signal of warning and guidance. Minot's Ledge is a sunken reef five miles off the Massachusetts coast. It was formerly one of the greatest dangers to navigation in the world, and the difficulties of constructing a lighthouse here were enormous. An iron structure built in 1849 was destroyed by a terrible storm within two years. Later, five years and endless pains were required to construct the present 88-foot granite shaft, whose stones are dovetailed and bolted together. This lighthouse is the key to Boston's sea-borne commerce, on which rests much of this great city's industries and prosperity. It may fittingly stand as the beacon light to guide us into the accompanying article.

To the east your eye will sweep out over the island-dotted harbor, crowded with giant liners and freighters from across the Atlantic, with the smaller vessels that ply between the cities of the Atlantic coast, with ferries, fishing craft, and pleasure yachts. Then as you slowly circle around, gazing far out to the horizon line, you will see an almost solid mass of roofs stretching north, west, and south, like one vast city. Within

the range of your eye live a million and three-quarters of people—nearly half the entire population of Massachusetts.

Boston itself covers only a small part of this district, having an area of 29,000 acres,—less than that of many a far less populous American city—but within a radius of ten miles beyond its limits lie about 20 towns and villages, so closely built that the casual visitor cannot tell when he passes from one to another. These many little independent units jealously preserve their separate existence, though for all practical purposes they form a single metropolitan area, with the result that their park, water supply, and the main drainage and sewerage systems are controlled by state-appointed commissions.

Memories of a Glorious Past

Now look more closely at the city which lies at your feet. What memories crowd upon the mind as

your eyes travel from one famous scene to another! Where else in America will you find so many relics of a great and glorious history, so many memories of illustrious men and illustrious deeds?

The State House where you have taken your stand is on Beacon Hill, not far from the center of the

Here criminals and Quakers were executed in the early days of Massachusetts Colony, here the British troops drilled before the battles of Bunker Hill and Lexington, and here the philosopher Ralph Waldo Emerson pastured his mother's cow, for up to 1830 the sedate folk of Beacon Hill used to send their

THE GREAT BOSTON PUBLIC LIBRARY



The Boston Public Library is built in Italian Renaissance style and surrounds an open court containing a fountain. Over the main entrance are reliefs by Saint Gaudens. The interior is decorated with mural paintings by Abbey, Sargent, Puvis de Chavannes, and other famous artists.

northward-pointing peninsula on which old Boston was built. Beacon Hill has been called the citadel of Boston aristocracy, for along its steep narrow streets are rows of serene and beautiful old dwellings in which have lived many of the men who have made American political and literary history. Here you may see the house in which the historian Parkman wrote for 20 years; in another Thomas Bailey Aldrich wrote his 'Story of a Bad Boy'; others have been the homes of Motley and Prescott; Ticknor and Alcott; Pinckney and Channing; Julia Ward Howe and William Dean Howells, and other famous persons.

Some distance beyond the foot of the hill to the west you see the beginning of the splendid wide embankment along the St. Charles River, which is one of the many notable public improvements of the last generation which have made Boston a place of beauty. To the southwest is the famous Common, a tree-dotted expanse of 48 acres in the heart of the city, with the smaller Public Gardens adjoining.

cattle to the Common to graze. Some of the famous men who often trod the Common in the days when the nation was in the making lie buried in the little Old Granary burying ground just to the northwest. There are the graves of Samuel Sewall, the parents of Benjamin Franklin, John Hancock, James Otis, and Samuel Adams.

Straight on past the Common and the Public Gardens along the broad Charles lies the fashionable Back Bay district, once a salt marsh but long since reclaimed at the expense of forests of timber, quarries of granite, and mountains of gravel. On the other side of the river you catch sight of the ivy-covered red brick buildings of Harvard University, lying in the heart of Cambridge, the most celebrated of Boston's suburbs (*see Cambridge*). Not far from the river is stately Commonwealth Avenue, 240 feet wide, with its strip of green parkway down the center adorned by statues of famous men. This is one of the links in Boston's famous park system, which girdles

HISTORIC SITES OF BOSTON



Of the many historic sites in and around Boston, some of the most interesting are here shown,—the Paul Revere house, the Old North Church from the spire of which tradition says the lanterns were hung on the night of that famous ride, the Old State House, Faneuil Hall, and the great granite shaft commemorating the heroism of the men who fought on Bunker Hill. The shaft is 220 feet high and inside of it is a stairway by which you can reach the summit.

the city with two rings of parks and playgrounds and boulevards so that there is no part of the whole metropolitan area without its breathing place. A few blocks south of Commonwealth Avenue is the scarcely less famous Boylston Street, with its many magnificent public buildings, churches, and hotels. About half a mile down it broadens into the green triangle of Copley Square, where you see one of the most famous groups of modern buildings in America. Here is the great Public Library, the second largest library of America and the largest circulating library in the world, adorned with mural paintings by Puvis de Chavannes, Edwin Austin Abbey, and John Singer Sargent. Opposite the library is one of the finest examples of ecclesiastical architecture in America, Trinity church, with its beautiful decorations and

stained glass windows by La Farge, William Morris, and Burne-Jones. Two other imposing structures also adorn Copley Square, the old Museum of Fine Arts and the New Old South Church. Boston University is a block beyond the square, and the famous Latin School, the oldest school in the country (founded in 1635), is a few blocks to the south. Along Huntington Avenue, one of the streets which meet at Copley Square, are many other notable buildings, among them Mechanics Hall, the mother church of Christian Science, Symphony Hall, the Opera House, and the Museum of Fine Arts, which has one of the world's greatest art collections.

Circling farther around the cupola to the south and east, you see at your feet the maze of narrow crooked streets that make up the business center. Washing-

ton Street is the most congested thoroughfare in the country, and several others are so narrow that traffic is permitted in only one direction. This, one of the oldest parts of Boston, is rich in historic buildings and associations. Here is the Old State House (1748), the seat of royal government of Massachusetts during the provincial period, now a historical museum. Under its balcony took place the fateful "Boston Massacre" of 1770, when ten citizens lost their lives in an encounter with the British soldiery. Not far away is Faneuil Hall (1763), the "cradle of American liberty," where the patriots often met during the Revolutionary period, and where in later times Webster, Choate, Sumner, Wendell Phillips, and Everett made the air ring with the thunders of their oratory. Old South Church, where Benjamin Franklin was baptized and where so many patriotic meetings were held that it gained the title of the "sanctuary of freedom," stands in the midst of a group of modern office buildings that far overtop its slender wooden spire. Tucked away in another corner is the old pillar-fronted King's Chapel (1749), where General Washington sat one day in 1789 when an oratorio was given in his honor. In the little burying ground adjoining are the graves of John Winthrop and John Cotton.

Looking northward to the site of the original city—now a crowded foreign district—you will make out the tower of Christ Church (also called Old North Church), the oldest church of the city (1723), whence it is supposed the lanterns were shown for Paul Revere's famous ride. Revere's house too is still standing, not far away, a little two-story building with a steep roof, almost lost among Italian shops and tenements. In Copp's Hill burial ground beyond Christ Church are the tombs of the Mathers.

Where Bunker Hill was Fought

Across the narrow dock-lined stretch of water, spanned by many bridges, that separates the North End from Charlestown, you see a plain square stone shaft rising high above the huddle of roofs. This is the Bunker Hill Monument, which commemorates one of the glorious episodes in American history. All the eastern end of the Charlestown peninsula is given over to the vast United States Navy Yard, which has stood here ever since 1800. At the piers or out in the open water lie scores of warships, little and big, contrasting strangely with the famous wooden frigate *Constitution*, or "Old Ironsides," as it is affectionately known, which is moored to one of the docks, glistening in all its splendor of black and white.

Such are a few of the historic scenes that crowd on your eye as it sweeps over the city. But however much we may like to dwell on the greatness of Boston's past, we must not forget the greatness of the modern city, the capital of Massachusetts, the metropolis of New England, and the seventh largest city of the country. Boston is the chief seaport of New England and fourth in rank of the seaports of the country. It is the chief wool market of the country, the chief fish market, and one of the leading

manufacturing cities, ranking high in the manufacture of shoes, clothing, pianos, organs, and other articles. It is one of the most important book-publishing centers, and also a leading financial center, the home of many powerful banks, railroads, insurance companies, and mining companies. Several transatlantic steamship companies, besides a host of smaller lines, make it a terminus.

As a center of education Boston is unsurpassed in America. Boston University, Boston College, Simmons College, the New England Conservatory of Music, the Harvard Medical and Dental Schools are in Boston. Harvard, Radcliffe, and the new home of the Massachusetts Institute of Technology are in Cambridge just across the Charles River. Wellesley College, Tufts College, and other well-known institutions are in adjoining suburbs.

The largest of the immediate suburbs of Boston, after Cambridge, is Somerville (about 95,000), which lies between Cambridge, Charlestown, and the Mystic River. The seven hills on which it is built were strongly fortified during the Revolution. The city's chief fame is as an attractive place of residence, but it also has large manufacturing interests, including meat packing and cloth bleaching and dyeing. Medford (40,000), Everett (40,000), and Chelsea (45,000), which lie along the farther bank of the Mystic, are also important manufacturing centers. In 1914 Chelsea was swept by a fire which demolished a large part of the city, doing \$17,000,000 worth of damage. Winthrop, at the point of a peninsula, and Revere, farther north along the bay, are both attractive residential places, famous for their beach resorts.

Brookline (40,000), which thrusts almost into the heart of Boston proper, is one of the most beautiful and wealthy residential suburbs in the country. It still retains its ancient town meeting form of government, as does the smaller suburb of Dedham. Another city of beautiful homes is Newton (50,000), the home of Newton Theological Seminary. Newton also has many mills and factories where silks, worsteds, and rubber goods are manufactured. In Mt. Auburn Cemetery at Watertown are the graves of Longfellow, Lowell, Sumner, Phillips Brooks, and other famous men. Waltham (30,000) is one of the chief manufacturing suburbs, with great watch factories, cotton mills, foundries, and clothing establishments. Arlington combines important gardening and manufacturing interests with attractiveness as a place of residence. Milton has played a conspicuous part in many historic episodes, and Quincy (50,000), on the South Shore, will always be famous as the home of the Adams family, many of whom are buried here.

The history of Boston is in large part the history of Massachusetts. It was founded in 1630 by Puritan settlers led by Gov. John Winthrop, and was first called Trimountaine from its three hills. The name was soon changed to Boston, from the town in Lincolnshire, England, whence many of the settlers had come, but the original name survives in "Tremont" Street.

Boston was the chief center of Puritanism and of learning

in America. Here were started the first newspapers (1690 and 1704). The same Puritan spirit which led to the punishment of heretics, Quakers, and witches contributed largely to making Boston the center of opposition to the oppressive measures of the mother country in the period preceding the Revolution. The Boston Massacre, the Tea Party, and the British evacuation of Boston are famous events. In the 19th century Boston retained its leadership in educational, cultural, and humanitarian lines. Many great literary men and scientists lived in or near the city, among them Longfellow, Lowell, Whittier, Emerson, Hawthorne, Holmes, Agassiz, Parkman, Motley, Prescott. The city also became the center of the anti-slavery movement.

In 1872 the city was visited by the greatest of several devastating fires which destroyed more than \$75,000,000 worth of property in the business section. In the rebuilding many of the narrow and winding streets were widened and straightened. For municipal improvements during the last generation, Boston stands in the first rank of American cities. It was a pioneer in the parks and playgrounds movements, and it has largely solved its transportation problems by a splendid system of subways, elevated railroads, and tunnels.

The population of Boston proper is about 750,000. Less than 25 per cent are native born of native parents. Boston is exceeded only by Dublin and Belfast in the number of its Irish population, including those born in this country of Irish parentage. It contains nearly 70,000 Canadians, more than 60,000 Russians, the majority of the latter Jews, and 50,000 Italians. The change which a century of immigration has worked is interestingly indicated by the fact that in this city of the Puritans the most numerous churches today are Roman Catholic, with Jewish places of worship taking second place.

BOTANY. It should be understood at the outset that botany is one division of biology, or the science of living beings, and that it simply means a study of biology with plants as illustrative material.

The history of botany is a very long one, but the real development of the science has taken place only during the last century. Naturally the first attention given to plants was to discover those which are useful to men for food, in the arts, or in medicine. In fact, the medicinal use of plants was for centuries the only representative of a botanical science. A true science of botany began with attempts to classify plants. Aristotle and Theophrastus, in the days of the ancient Greeks, had classified all plants as trees, shrubs, and herbs, and there was no further attempt to develop a scientific knowledge of plants until the 16th century. It was then that students again began to arrange plants into groups, but the groups were artificial. These attempts culminated in the famous artificial system of the Swedish botanist Linnaeus, published in the middle of the 18th century and in use to the middle of the 19th century.

Since the days of Linnaeus a great advance has been made in constructing what are known as natural systems of classification, which attempts to put together those plants which are really related. As a consequence, the subject of classification, or *taxonomy* as it is called, is now upon a very substantial basis. Taxonomy is the oldest phase of botany and to many it continues to represent the whole subject. It is not unusual to meet people who think of botany as the analysis of flowers. Of course, taxonomy includes

the classification of flowering plants, but it includes a classification of all other plants as well.

What the Microscope Did for Botany

During the latter part of the 18th century a new phase of botany began to be developed, which deals with the structure and development of plants and their organs. This study became possible only through the invention and gradual improvement of the microscope, by means of which the minute structures of plants could be investigated. At first botanists interested themselves merely in the structure of mature plant bodies; but as there gradually developed the knowledge of the cell, as the basis of living bodies, the field of *plant anatomy* came into view. This has to do with the various cell aggregates known as "tissues" which enter into the plant body. Still later, botanists began to be more interested in the way in which the tissues are related to one another to form the plant body and its organs, and the science of *plant morphology* began to exist. This last subject for a time contented itself with the study of the forms of plants and their organs, but presently passed into the more important phase of studying the gradual development of plants and of their organs, subjects which are often called *embryology* and *organology*. Morphology not merely studies the development of structures, but it studies the relationships of plants which are thus revealed, and hence is interested in what is known as *phylogeny*, that is, the ancestral history of plant groups.

Plants at Work

During the time that plant morphology was coming to the front, another view of plants was being developed, namely, that which deals with their life processes, or the plants at work. A good many botanists cared not so much for the structure of plants as for the activities of plants, and *plant physiology* began to assume importance. This subject developed with exceeding rapidity during the 19th century. It is certainly one of the most important views which can be taken of plants.

During recent years still another field of botany has come prominently forward, which deals with plants in relation to their environment, and is known as *ecology*. Under this phase the necessary relations of plants and their organs to light, heat, soil, temperature, etc., are studied, and also those exceedingly interesting communities known as "plant societies."

Most recent of all the phases of botany is *plant breeding*. This and animal breeding constitute *genetics*, the scientific study of inheritance. The plant-breeder, by hybridizing, selecting, and pedigreeing is able to produce new and valuable types of plants.

The foregoing may be taken to represent the principal fields of botanical activity today, but there are other botanical subjects which are of more special development. For example, *plant pathology* deals with the diseases of plants, *paleobotany* with fossil plants, *economic botany* with plants in relation to the interests of man, *forestry* with the problems of the proper

LOOKING INTO THE HEART OF A GROWING PLANT



Here we see each stage of development from the new bud to the grown flower



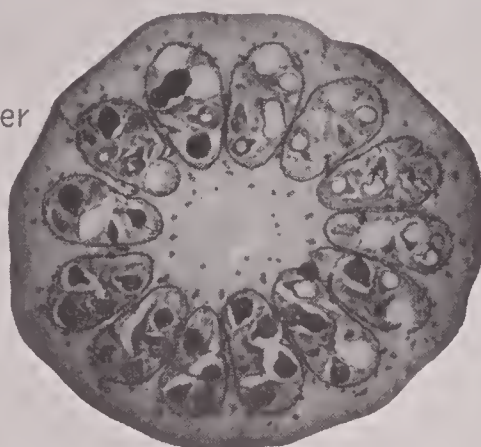
A botanist taking photomicrographs



Watching a leaf "grow up" is interesting. This leaf is all curled up when "born," but as it develops it keeps uncurling until it is flat



The matured flower opens up to receive the air and sunlight



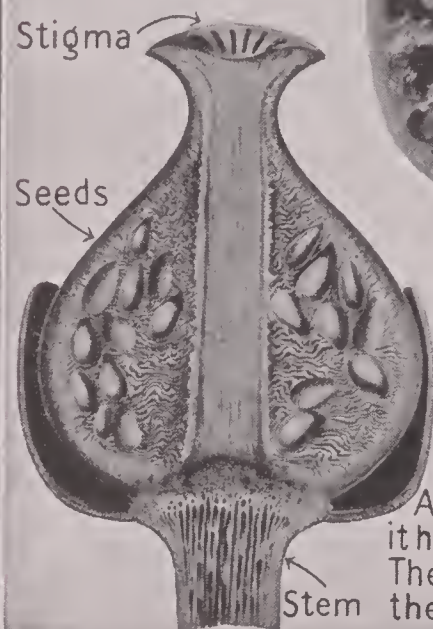
The unripe fruit is here cut in half to show how the young seeds rest in their cradles



This magnified view of the leaf bud cut in half shows how it looks curled up



Here the seeds are old enough to drop out and take root

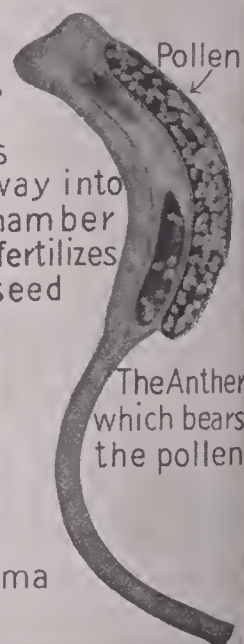


A peep into the pistil after it has ripened into the fruit. The stamens, having done their work, have disappeared

The stigma at the top of the fruit receives and holds the pollen grains, while each grain sends out a slender tube. This finds its way into the seed chamber and fertilizes a seed



Stigma



Botanists study plants in much the same way as physicians study the human body. They cut sections of the delicate parts and examine them with microscopes, make chemical analyses of the plant's tissues, and so are able to give us the hidden secrets of plant anatomy. At the top we see the method by which botanists take greatly enlarged photographs of plants. A microscope is substituted for the lens of an ordinary camera, and an intense light is focused upon the part to be photographed. The remaining pictures, telling the structure and life history of the yellow Water Lily, illustrate the manner in which the thousands upon thousands of different plant species are "described," before they are given their rank and classification. These pictures not only show the plant's anatomy, but also how the flower develops from the tiny bud to the mature seed case.

For any subject not found in its alphabetical place see information

cultivation and use of forests. Still further subdivisions of the general subject are common. A *bacteriologist* is one whose attention is devoted to the study of bacteria, those minute microscopic plants which cause many diseases and are important in other ways. The *phycologist* studies the algae; the *mycologist* studies the fungi, the *bryologist* is a student of mosses, etc.

What the Young Botanist Should Learn

A real elementary knowledge of botany should include something from all the principal divisions of the subject. For example, a beginning student should know how plants must relate themselves to their surroundings in order to live (*ecology*). He should know how plants make food and use it, how they are irritable and respond to stimuli, and how they produce (*physiology*). He should also learn something of the essential structures of the great groups so that he may know the make-up of a toadstool, moss, fern, flowering plant, etc. (*morphology*). In addition he should have some general knowledge as to how plants are put into great natural groups or families, and he should be able to discover the names of the most important plants of his vicinity (*taxonomy*).

BOTHA (*bō'tā*), LOUIS (1862-1919). "I want the king and the British people to realize that the trust reposed in us has been worthily taken up," said General Louis Botha in 1910, when he became prime minister of the newly formed Union of South Africa under the British crown. "I hope they will have cause of pride in the young South African nation."

And yet the man who spoke these words had less than ten years before been commander-in-chief of the Boer forces in their disastrous war against Great Britain. Resisting to the last, when he saw that the cause of Boer independence was doomed, he made the best terms he could for his people; and in 1907, when the Liberal party in England gave the Transvaal self-government, he became the first premier.

The pledge of loyalty he gave three years later when advanced to the premiership of the Union of South Africa was nobly redeemed in the World War of 1914-18. Scorning the attempts of Germany to induce the Boers to revolt from the British Empire, he rallied his countrymen to the Allied cause, took command of their forces, and in a few months had compelled the surrender of all the German troops in Southwest Africa.

Botha's life was crowded with stirring scenes. During his youth he served in wars against the South African savages, and in 1899, when the conflict broke out with Great Britain, he quickly rose to the supreme command of the Boer armies. He died in Pretoria during an influenza epidemic in August 1919, mourned throughout the whole empire. Of contemporary statesmen of the British colonial possessions, none ranked higher than General Louis Botha and his companion-in-arms, General Jan Christian Smuts.

BOWLING. From the old outdoor English game of "bowls" has developed in America one of the most popular of winter indoor sports; for bowling is

a game that demands of the player great precision of hand and eye, and that requires enough exertion to supply the physical exercise that many people might otherwise lack during the winter months.

The English game of bowls is played on a smoothly rolled lawn, and the object of the game is to roll wooden balls along a 40-yard course in such a way as to bring them to rest near a white earthenware ball called the "jack" or "kitty." The player whose ball is nearest the jack is, of course, the winner.

The American game of bowling is quite different from its English predecessor. It is played indoors on a smoothly polished wooden floor, or "alley," about 42 inches wide and about 70 feet long. At one end ten wooden pins are placed on end in a triangular space. From the center of Number 1 pin to the foul line, behind which the bowlers must deliver the ball, is 60 feet. The player rolls wooden balls the length of the alley in an endeavor to knock down all of the pins. If he succeeds in doing that with the first ball or the first two balls, it counts extra on his score.

The American game is played in three chief ways, the difference being largely in the size of the balls and the pins used. In the Eastern States, and particularly in New England, "Boston pins" is the more common game. It is played with balls about 5 inches in diameter, and with pins about 3 inches in diameter and 15 inches high. In the game called "candlepins," the "dead-wood" or fallen pins are allowed to remain where they fall and may sometimes be struck in such a way as to help bring down the pins left standing. In "Boston pins" this "dead-wood" is removed after each shot. Three balls are used in these games.

But the version of bowling that is more generally known throughout the United States, and that is particularly favored in the Middle West, is the one in which large bottle-like pins are used and the player rolls large balls between 8 and 9 inches in diameter and about 15 pounds in weight. Two or three holes in the side of the ball allow the player to insert his fingers and grip it firmly as he sends it down the alley.

The Methods of Scoring

Scoring methods are the same in all the games. The score for each "box" is the number of pins that have been knocked down. If all the pins have been knocked down with two balls, it is called a "spare," and the player may add to the score of ten the number of pins knocked down by the first ball of the *next* series. If he knocks all ten down by the first ball rolled it is called a "strike," and he may add to the score of that box the result of the first two balls rolled in the *next* box, and so on.

Candle or Boston pin bowling is a little more difficult than with the larger balls and pins, and the possible scores are not so high. In candle pins the score of 300 has never been made; in ten-pins it has been made many times by good bowlers.

In bottle pins only two balls are rolled in each series or "box," but the rule as to strikes and spares is the same as in candle pins.

Many clubs have bowling teams of five men each, and every large city has its various bowling leagues which compete in matches throughout the winter months. The sport has been particularly popular in recent years.

BOXING. The "manly art of self-defense" has long been the accepted description of boxing; and it is a manly art, for it demands of anyone who masters it self-control, strength, agility, endurance, and power to coördinate thought and action—all manly qualities. More than any other sport, perhaps, boxing tests one's self-control; it almost always happens that the boxer who remains cool, who refrains from becoming excited and keeps his temper, will "outpoint" an opponent who "goes up in the air." In addition to the exercise that the sport affords, there is, of course, a large benefit in the self-confidence that it brings to the boy or man who, having mastered it, knows that he is able to take care of himself in any emergency that may arise.

The proper time to begin learning to box is early in boyhood, for the same principle applies in this sport that applies to all others—the earlier the start the more rapid the progress. The gymnasium floor or any open space indoors or out will serve as a boxing "ring." The only equipment needed is two pairs of well-padded gloves.

Some of the rules which have made boxing a clean sport are as follows: All of the hitting must be done with the gloved fists; butting, kicking, and tripping are not allowed; wrestling holds and hitting below the belt are also forbidden. The usual length of the rounds in matches is three minutes, with one minute of rest at the close of each round. If either boxer is "floored" by his opponent he must get to his feet within ten seconds or lose the bout. Hitting an opponent when he is down is prohibited. These regulations are a part of what are known as the Marquis of Queensberry rules, and have done much to maintain the fairness of the sport.

There is no doubt that boxing is of great antiquity, for it is mentioned in Homer and it formed a recognized part of the Olympian games and Roman contests. Ancient boxing was with the bare fists, or even with the hands reinforced with a *cestus* of bronze or rawhide straps. The use of the padded gloves, which is now general in contests, dates from about 1760. In Y.M.C.A. gymnasiums, schools, and colleges, boxing is now encouraged as a valuable athletic sport, especially during the winter when there is no opportunity for baseball and football. In the interest of fair play, boxers are classified according to their weights as follows: bantam weight, 116 pounds or under; feather weight, 116 to 122 pounds; light weight, 122 to 133; welter weight, 133 to 145; middle weight, 145 to 158; and heavy weight, 158 or over.

Below are some of the terms that are in common use in boxing: "On guard" means the position that

the boxer assumes when awaiting the attack of an opponent. Usually he stands alertly poised with his left foot forward, his left knee slightly bent, his right forearm across the lower part of his chest, and his left arm partly extended with his gloved fist pointed at his opponent. "Lead off" indicates the blow with which a boxer begins his attack. "Breaking ground" means giving way before the attack of the opposing boxer. "Counter" is a blow given in response to an opponent's lead off, as nearly as possibly simultaneously. "Upper cut" is a short blow delivered in an upward direction with the arm bent; this is used when boxing at close quarters and is aimed ordinarily at the chin. "Feint" is a feigned attack preliminary to the real attack—for example, a lead off for the head with the object of inducing an opponent to raise his guard and thereby open himself to a body blow. "In fighting" means boxing at close quarters.

In training for boxing it is well to take those exercises that increase one's agility and quickness and that add to one's "wind" and endurance. Sprinting, tennis, and work with the punching bag are examples of the exercise that a boxer may engage in with advantage. But of course the best way to become an adept is to engage in friendly boxing matches whenever an opportunity is offered.

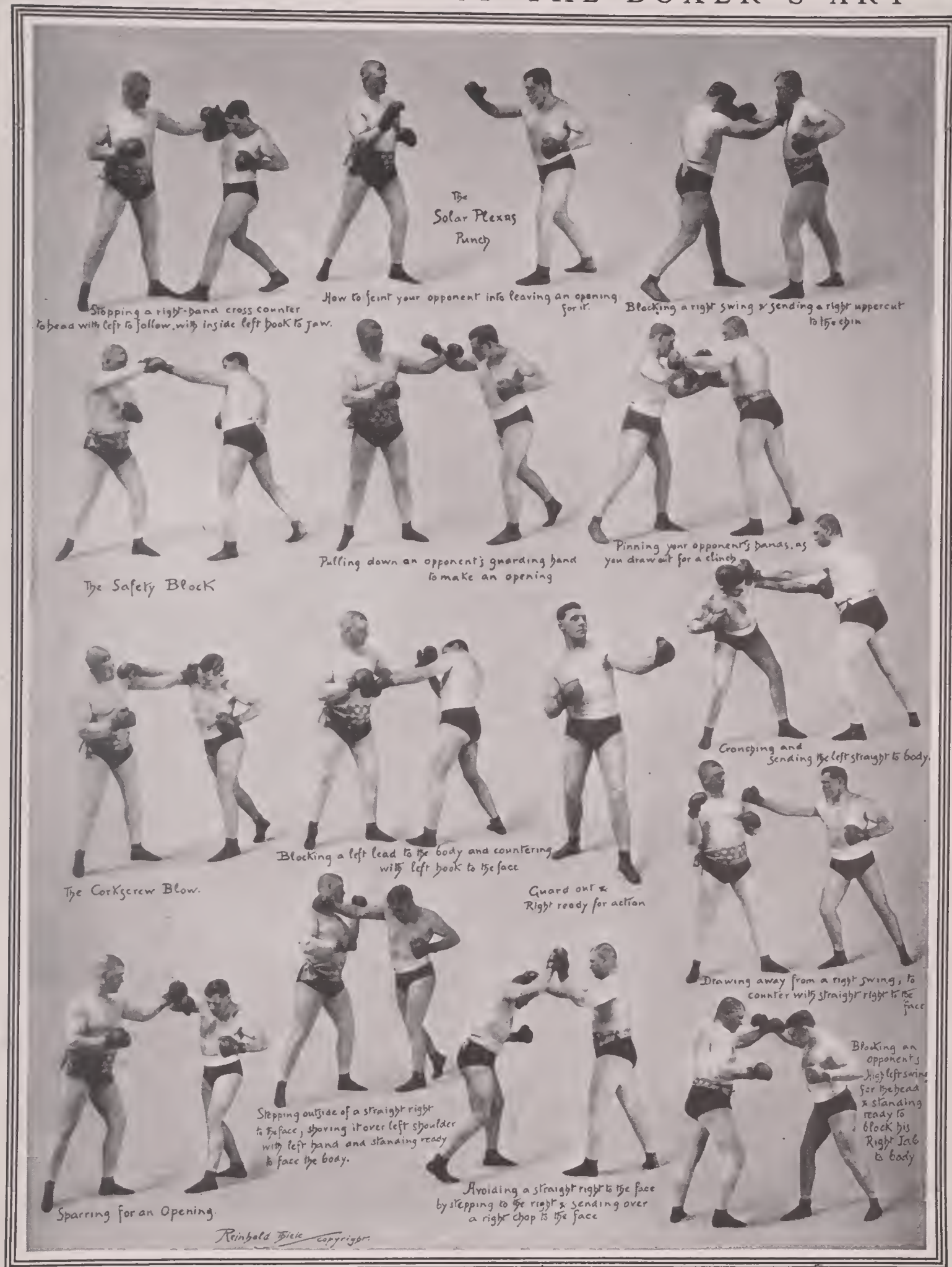
BOYCOTT. In the year 1880 there was much commotion in County Mayo, in the west of Ireland. The whole of the island was then in the midst of the great land struggle, with its demand for the "three F's"—*fixity of tenure*, or the right of the tenant to keep his land as long as he paid the rent for it; *free sale*, or the right to sell his interest in the land to whomever he wished; and *fair rent*, which would prevent the landlord from raising the rent unjustly. To enforce these demands the Irish Land League was formed, the members of which agreed that any landlord or agent who refused to grant their demands should be "isolated from his kind as if he had been a leper of old."

Capt. Charles C. Boycott was the agent in County Mayo for the extensive estates of an Irish lord and was the first victim of this agreement. From him we get the now common word "boycott," meaning to combine against a man or group of men by refusing to deal with him, to buy from or sell to him, or have social relations with him. In the last sense it is about the same as "sending a person to Coventry."

Because Captain Boycott would not come to terms with his tenants, the population for miles around would have nothing to do with him or his family. His servants were coaxed or driven away, his food supplies were interfered with, and his fences were torn down. He was finally reduced to such dire straits that he had to leave the country.

The boycott is now frequently used by labor unions in their disputes. English courts have recognized the legality of the boycott, but American courts have taken a strong stand in opposition to it, and a number of states have passed laws against its use. Nations sometimes use the boycott against other nations, as when Chinese merchants refused to buy Japanese goods because of the friction between the two countries.

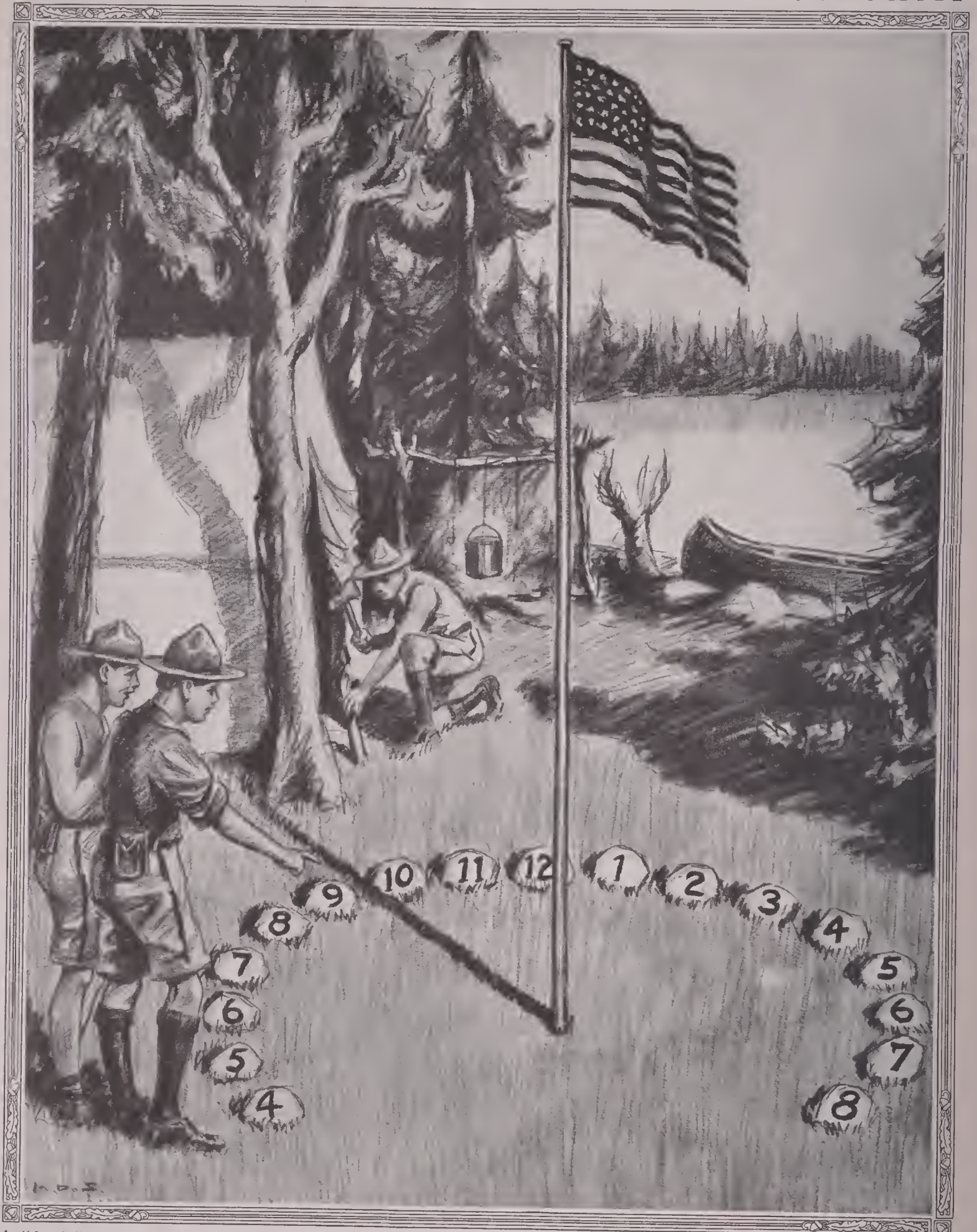
A FEW GLIMPSES OF THE BOXER'S ART



Two skilful boxers standing before a camera illustrated these various features of the art of boxing. There are 15 features here shown, but they are by no means all that have been evolved in the long history of this form of athletics, which reaches at least back to Homer's time. The maneuvers of the ironclad knights, which are given so conspicuous a place in literature relating to the Middle Ages, were simple compared to the strategy of boxing.

contained in the Easy Reference Fact-Index at the end of this work

A SIMPLE SUN DIAL FOR A BOY SCOUT CAMP



A "dandy" sundial for a boys' camp, which will tell time accurately when the sun is "on the job," can be made very easily, as shown in this picture. You should see that the flagstaff is set in an open space at one end of the camp. Then get 17 stones, all of about the same size, paint them white, and on this background paint the hours with black numbers. Consulting a watch, place the stones where the shadow falls at each hour from sunrise to sunset. You can easily guess the half and quarter hours, but for greater accuracy stakes may be placed between the stones—a longer stake, say, for half hours and a shorter one for the quarter hours. Since the length of the day is constantly changing, so simple a dial as this would not indicate the correct time for more than a few days.

For any subject not found in its alphabetical place see information

What a BOY SCOUT NEEDS to KNOW



BOY SCOUTS OF AMERICA.

Scouting gives a boy something to do, something he likes to do, something worth doing. It has succeeded in doing what no other plan of education has done—made the boy want to learn. It organizes the gang spirit into group loyalty.

It provides a sane and happy substitute for occupations such as Satan proverbially finds for idle hands. A famous juvenile court judge once said that he never had a scout up in his court for his judgment, and that if all the boys in his city were Boy Scouts the court might just as well close. Scouting offsets the defects and neutralizes the dangers wrought by our over-civilized modern world.

A merchant who had been born on a pioneer farm once pointed out the contrast between the old days and the new in these words:

It was worth while being a boy 50 years ago. I could ride a horse to water, carry in wood, and drop corn behind a plow when I was four years old. At 10 I could curry a horse, clean a stable, milk a cow, saw wood, hoe the garden, and turn a grindstone. I could ride and shoot and swim and fish and go on snow-shoes like an Indian; find my way in the woods by blazes on the trees and by the stars; catch and cook my own supper, and make a good shelter and bed. I knew all the wild plants and birds and animals. A boy had to rely on himself in those days and be of use to others, and it made a man of him. The good old chores and sports are all gone. No wonder the boys of today are so often good for nothing.

With "scouting" the "good old times" come back again, alike for the country and the city boy. The scout learns to know and love the great outdoors intelligently. He camps and hikes and swims; studies birds and trees and stars; knows how to care for him-

A BOYS' club of more than half a million persons, the motto of which is "Be Prepared," and whose members are uniformed, drilled, and trained to efficient citizenship, with a view to service as embodied in the idea of the "Good Turn"—such is the Boy Scouts of America. This article tells you what the Boy Scout movement is, how you can become a member, the scout's equipment, and the tests you must pass to advance from the rank of tenderfoot to that of second class and first class scout; also how the merit badges are won.

self in the open, how to build fires and make camp cookery; how to set up tents and make himself comfortable and safe even under open skies if necessary; how to tie knots and how to use an ax and knife. *Be Prepared* is the scout motto, and preparedness of this kind is good training for every man.

Incidentally a scout also learns self-reliance, resourcefulness, courage, fair play, obedience, loyalty, and other so-called "old-fashioned" virtues, which are as valuable in the 20th century as they ever were in the past. Thousands of ex-scouts served splendidly in our American Expeditionary Force, and it is the verdict of officers both in the British and Canadian as well as our own forces that scout-trained boys almost invariably made the best soldiers. Not that they are trained to be soldiers. Quite the contrary, for the movement is distinctly non-military. But they are trained to be *men*, which is the essential thing either in peace or war.

Good Citizenship and Service Its Aims

Good citizenship making is the end and aim of Scouting. The movement believes that by making better American boys, fit every way—mentally, morally, and physically—it can best serve the nation and provide a vital man-power of brains, efficiency, and high moral standard.

The idea of *service* is fundamental in the scout movement. The daily good turn which every scout promises to perform is a small thing in itself, but it represents a big thing—perhaps the biggest thing, the most redeeming force in the world,—the willingness to serve others unselfishly, simply, looking for no reward; a service done for the love of service itself. The good turn magnified means community service. And everyone familiar with scouting knows what a record along this line boy scouts have, how they serve as traffic guides, police aides, messengers, distributors of "literature," collectors of newspapers and rubbish, etc.; how they have led in innumerable "clean-up," "swat-the-fly," "walk-rite," and "city beautiful" campaigns; how they have coöperated with fire commissioners, park commissioners, fish and game commissioners, forest wardens, etc.—active and enthusiastic in every undertaking which contributes to the betterment of the community and constitutes social service.

The national service record of Boy Scouts in the World War is little short of phenomenal. In the Liberty Loan campaigns they sold bonds to the amount

of \$301,000,000, and War Savings Stamps to an amount over \$50,000,000. They operated thousands of war gardens, worked on farms and in orchards and canning factories; located standing black walnut trees, collected 100 carloads of gas-mask material, and took a labor census for the State of Pennsylvania; coöperated with the Naval Intelligence Bureau, with the American Red Cross, Y.M.C.A., Jewish Welfare Board, Knights of Columbus, War Camp Community Service, the Committee on Public Information, and dozens of other patriotic agencies; collected books and magazines for soldiers; distributed 30,000,000 pieces of patriotic literature; rendered remarkable first aid and other service in connection with the influenza epidemic and such catastrophes as the Perth Amboy explosion, besides performing a multitude of other services. The scout's agreement to "be helpful to all people at all times" is not an idle phrase. The scout reputation for service is well earned, as everyone will attest who knows the facts of scout coöperation in government and community activities during the past few years.

Every boy who becomes a member of the Boy Scouts of America takes an oath and subscribes to the Scout Law of the movement. He also takes the oath of allegiance to the flag. Before he becomes a scout the boy must promise:

"On my honor I will do my best—

To do my duty to God and my country, and to obey the scout law;

To help other people at all times;

To keep myself physically strong, mentally awake, and morally straight."

A scout is required to know the Scout oath and law and to subscribe to both. But his obligation does not end here. He is expected not only not to forget his oath and law, but to live up to them in letter and spirit from first to last.

A boy who wants to become a scout should apply

to the local scouting authorities if scouting is established in his community. Through these local leaders he will be given an opportunity to join a troop already established, or machinery will be set in motion for the organization of a new troop, if the boy knows of others who also would like to become scouts.

Scouting is supervised by local councils in over 400 cities and towns, and other such councils are being constantly established.

Any man or boy interested in starting scouting in a community should write at once to national headquarters, 200 Fifth Avenue, New York City, and secure the necessary information as to procedure and copies of the many available pieces of scout literature. The official 'Scout Handbook for Boys' is obtainable either from local booksellers or national headquarters.

It is necessary to have at least eight boys, or one patrol, to organize a Boy Scout troop. A full troop consists of 32 boys—that is, four patrols of eight boys each. These troops must be under the leadership and direction of a scout master, who must be at least 21 years of age and must receive his commission from the national council at the recommendation of the church, or institution, or group of adult male

American citizens, who make themselves responsible for the troop in accordance with the requirements of the national council. Each troop has at least one assistant scout master, who must be 18 years old or over, and must be commissioned by the national council.

Every troop of Boy Scouts is under the supervision of a troop committee, consisting of three or more adult American citizens, representing the church or other institution or group of men, who select the scout master and make themselves responsible for the execution of the scout program of the troop, and for the provision of suitable facilities for the same.

In a community under a local council, the latter unit has general supervision of scout activities in the

THE SCOUT LAW

1. *A scout is trustworthy.* A scout's honor is to be trusted. If he were to violate his honor by telling a lie, or by cheating, or by not doing exactly a given task, when trusted on his honor, he may be directed to hand over his scout badge.

2. *A scout is loyal.* He is loyal to all to whom loyalty is due: his scout leader, his home and parents and country.

3. *A scout is helpful.* He must be prepared at any time to save life, help injured persons, and share the home duties. He must do at least one good turn to somebody every day.

4. *A scout is friendly.* He is a friend to all and a brother to every other scout.

5. *A scout is courteous.* He is polite to all, especially to women, children, old people, and the weak and helpless. He must not take pay for being helpful or courteous.

6. *A scout is kind.* He is a friend to animals. He will not kill nor hurt any living creature needlessly, but will strive to save and protect all harmless life.

7. *A scout is obedient.* He obeys his parents, scout master, patrol leader, and all other duly constituted authorities.

8. *A scout is cheerful.* He smiles whenever he can. His obedience to orders is prompt and cheery. He never shirks nor grumbles at hardships.

9. *A scout is thrifty.* He does not wantonly destroy property. He works faithfully, wastes nothing, and makes the best use of his opportunities. He saves his money so that he may pay his own way, be generous to those in need, and helpful to worthy objects. He may work for pay, but must not receive tips for courtesies or good turns.

10. *A scout is brave.* He has the courage to face danger in spite of fear, and has to stand up for the right against the coaxings of friends or the jeers or threats of enemies, and defeat does not down him.

11. *A scout is clean.* He keeps clean in body and thought, stands for clean speech, clean sport, clean habits, and travels with a clean crowd.

12. *A scout is reverent.* He is reverent toward God. He is faithful in his religious duties and respects the convictions of others in matters of custom and religion.

THE SCOUT LAWS IN DAILY LIFE



1. A Scout is trustworthy



2. A Scout is loyal



3. A Scout is helpful



4. A Scout is friendly



5. A Scout is courteous



6. A Scout is kind



7. A Scout is obedient



8. A Scout is cheerful



9. A Scout is thrifty



10. A Scout is brave



11. A Scout is clean



12. A Scout is reverent

Here are 12 of the hundreds and hundreds of ways in which a Boy Scout obeys the "Twelve Commandments" of the great scout Tables of the Law—examples of trustworthiness, loyalty, helpfulness, friendliness, courtesy, kindness, obedience, cheerfulness, thrift, courage, cleanliness, and reverence.

contained in the Easy Reference Fact-Index at the end of this work

SUMMER DELIGHTS OF WOODS AND WATERS



Just to look at a place like this—and much more, if one were actually there—would lead one to suppose that the Boy Scouts were mainly organized for the purpose of getting the keenest possible enjoyment out of life! And this is more or less true; for it is not only in the sport and the outdoor life of the summer camp that the joy of being a scout consists, but the pleasure of service; it is even better to give than to receive.

community. The troop committee deals directly with its own troop, and is entitled to a representative on the local council. Where there is a local council all matters which have to be referred to the national council pass through its hands. Otherwise a member of the troop committee deals directly with national headquarters.

A boy must be at least 12 years of age to be eligible to membership in a scout troop. There is no upward age limit. Older boys frequently become assistant scout masters, and aid in giving troop instruction. After five years of continuous service in scouting a scout is entitled to the designation of "veteran scout."

Classes of Scouts and Requirements

There are three classes of scouts, known respectively as tenderfoot, second, and first class scouts. A first class scout is eligible to the advanced ranks of life, star, and eagle scout, which require highly specialized training and requirements, as follows:

Tenderfoot—

1. Know the Scout law, motto, sign, salute, and significance of the badges.
2. Know the composition and history of the national flag and the customary forms of respect due it.
3. Tie the following knots: square or reef, sheet-bend, bowline, fisherman's, sheepshank, halter, clove hitch, timber hitch, and two half hitches.

Second Class Scout—

1. At least one month's service as a tenderfoot.

2. Elementary first aid and bandaging: Know the general directions for first aid for injuries; know treatment for fainting, shock, fractures, bruises, sprains, injuries in which the skin is broken, burns and scalds; demonstrate how to carry injured, the use of the triangular and roller bandages and tourniquet.

3. Elementary signaling: Know the alphabet of the semaphore or the general service (international Morse) code.

4. Track half a mile in 25 minutes; or, if in town, describe satisfactorily the contents of one store window out of four observed for one minute each.

5. Go a mile in 12 minutes at scout's pace—about 50 steps running and 50 walking, alternately.

6. Use properly knife or hatchet.

7. Prove ability to build a fire in the open, using not more than two matches.

8. Cook a quarter of a pound of meat and two potatoes in the open without any cooking utensils.

9. Earn and deposit at least one dollar in a public bank. (Liberty Loan subscriptions and War Savings certificates are accepted.)

10. Know the 16 principal points of the compass.

First Class Scout—

1. Swim 50 yards.

2. Earn and deposit at least two dollars in a public bank. (Liberty Loan subscriptions and War Savings certificates are accepted.)

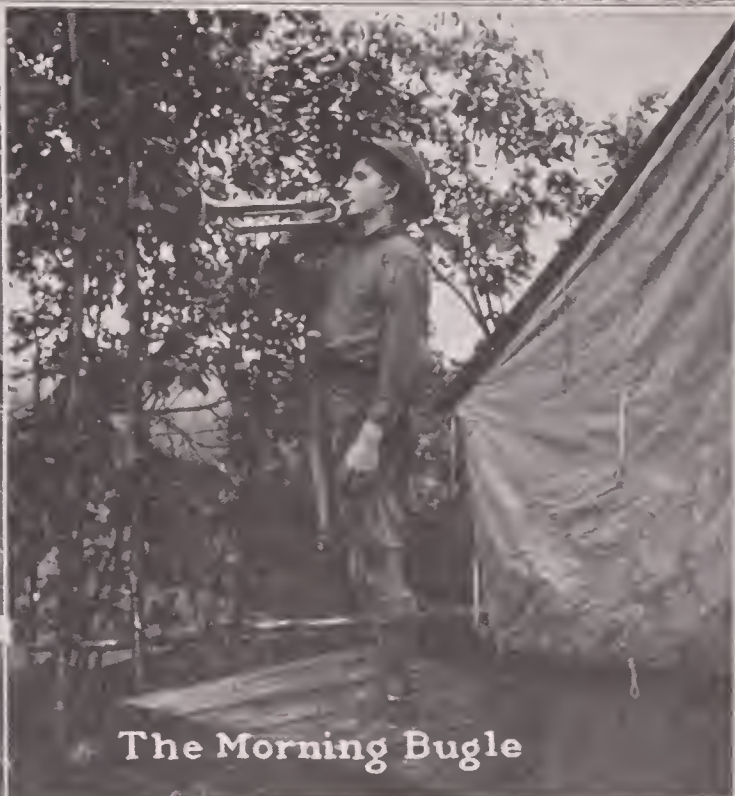
3. Send and receive a message by semaphore, including conventional signs, 30 letters per minute, or by the general service code (international Morse), 16 letters per minute, including conventional signs.

4. Make a round trip alone (or with another scout) to a point at least seven miles away going on foot or rowing boat, and write a satisfactory account of the trip.

For any subject not found in its alphabetical place see information

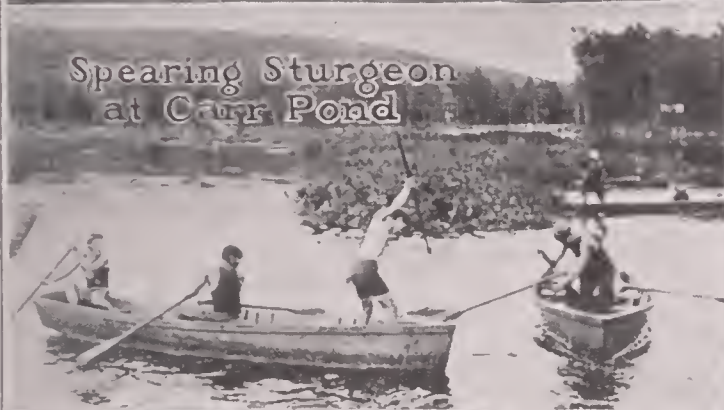
VARIOUS PHASES OF BOY SCOUT LIFE

Building a Fire

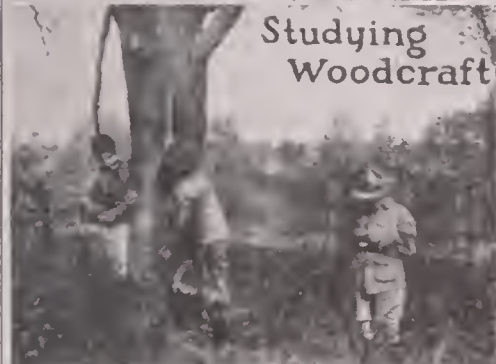


The Morning Bugle

Spearing Sturgeon
at Carr Pond



Studying
Woodcraft



Tent Mess



A Bout with the Gloves



Work in the Garden

From the morning bugle to bed-time, life in a Boy Scout camp is a continuous series of "something doing." In the first picture two boys are passing one of the tests for second class scouts by building a fire in the open. Below the boy with the bugle the scouts are at the noonday mess under the shady tent. The scene in the garden is not a part of camp life, but illustrates one of the important contributions made by the Boy Scouts toward winning the World War. To the left two youngsters are engaged in a bout with the gloves. Above them a group of three are studying woodcraft, while their picture neighbors are spearing sturgeon in a pond. Now, as a matter of fact (I'll tell you this privately) this "sturgeon" was made of straw for the boys to practice their skill upon!

contained in the Easy Reference Fact-Index at the end of this work

BRINGING WATER UP FROM THE SPRING



Here is another scene in the woods, in a permanent Boy Scout camp, showing boys bringing water from the spring. Could anything be more picturesque, with the graceful trees in the morning light, the shrubbery and the vines? There is evidently quite a slope down to the spring and crude steps have been made leading up to scout headquarters.

5. Advanced first aid: Knowing the methods for panic prevention; what to do in case of fire, ice, electric, and gas accidents; how to help in case of runaway horse, mad dog, or snake bite; treatment for dislocations, unconsciousness, poisoning, fainting, apoplexy, sunstroke, heat exhaustion, and freezing; know treatment for sunburn, ivy poisoning, bites and stings, nosebleed, earache, toothache, inflammation or grit in eye, cramp or stomach ache, and chills; demonstrate artificial respiration.

6. Prepare and cook satisfactorily, in the open, using camp-cooking utensils, two of the following articles as may be directed: eggs, bacon, hunter's stew, fish, fowl, game, pancakes, hoe-cake, biscuit, hardtack or a "twist" baked on a stick; explain to another boy the methods followed.

7. Read a map correctly, and draw from field notes made on the spot an intelligible rough sketch map, indicating by their proper marks important buildings, roads, trolley lines, main landmarks, principal elevations, etc. Point out a compass direction without the help of the compass.

8. Use properly an ax for felling or trimming light timber; or produce an article of carpentry, cabinet-making, or metal work made by himself. Explain the method followed.

9. Judge distance, size, number, height, and weight within 25 per cent.

10. Describe fully from observation ten species of trees or plants (including poison ivy), by their bark, leaves, flowers, fruit, or scent; or six species of wild birds by their plumage, notes, tracks, or habits; or six species of native wild animals by their form, color, call, tracks, or habits; find the North Star, and name and describe at least three constellations of stars.

11. Furnish satisfactory evidence that he has put into practice in his daily life the principles of the scout oath and law.

12. Enlist a boy trained by himself in the requirements of a tenderfoot.

Merit Badges and How They are Won

A first class scout may qualify in any or all of the merit badge subjects, which include a wide range of activity, such as bee-keeping, photography, pathfinding, public health, firemanship, aviation, etc. The requirements for these merit badges are given in the official 'Boy Scout Handbook'. There is an appropriate badge for each rank in scouting.

Life Scout Requirement—

The life scout badge is awarded to all first class scouts who have qualified for the merit badges of first aid, physical development or athletics, personal health, public health, and life-saving or pioneering.

Star Scout Requirement—

The star scout badge is awarded to the first class scout who has qualified for ten merit badges, including the five badges of the life scout.

Eagle Scout Requirement—

The eagle scout badge is awarded to any first class scout qualifying for 21 badges. These 21 badges shall include first aid, life-saving, personal health, public health, cooking, camping, bird study, pathfinding, pioneering, athletics or physical development, and any 10 others.

There are at present on record at national headquarters over 900 eagle scouts, representing the highest rank attainable in scouting.

Medals for conspicuous bravery in life-saving are conferred by the national court of honor. To date

4 gold, 14 silver, and 36 bronze medals have been awarded. A medal is also offered for distinguished service to wild life. Details of conditions of award of this medal are given in the 'Scout Handbook for Boys'.

The Treasury Department has awarded 66,725 medals, and 10,152 bars for distinguished service in the sale of Liberty Bonds; 33,937 medals, 40,733 palms, for War Savings Stamps; and 875 medals for gardening service.

The possession of a Boy Scout uniform and personal equipment is not obligatory, but is strongly advised. Scouts are encouraged to earn their own equipment as well as their registration fees. They are expected to keep their uniforms in good condition and to respect them as the symbol of the things for which scouting stands. The scout uniform as authorized by the Boy Scouts of America is described as follows in the constitution:

Hat, olive drab, flat brim; shirt, khaki, coat style, bellows pockets; coat, khaki, four bellows pockets, standing collar, metal buttons with scout emblem; shorts, or breeches, standard khaki material; belt, olive drab web; haversack, worn as a knapsack; shoulder knots, 5½ inches, worn in colors of patrol on right shoulder; leggings or stockings to match uniform.

Other useful articles of equipment are the staff, lanyard, knife, ax, canteen, and first-aid kit, etc. Those interested in available supplies and prices should consult the catalogue issue of *Scouting*, which will be mailed upon request to national headquarters.

Other equipment is usually owned by the troop as a whole. It may consist of signaling and camping outfits, troop and national flags, books, etc. The troop committee is responsible for this general troop property. In the event of a troop's disbanding, the committee arranges for the equitable disposition of the property.

The troop committee is responsible for securing a suitable meeting place for the troop. This is more easily and permanently arranged when troops are connected with an established institution like a school or church. In some cases troop headquarters are donated by public-spirited men, and sometimes the boys themselves build a rough shack which is doubly dear to them because so peculiarly their own. The scouts often make their own furniture also, which fits in well with manual training work done in school, with requirement No. 8, first class scout, and with the merit badge in carpentry and cabinet-making.

Every troop has its own number and colors, which

color appears in the neckerchief worn by the troop's members. Every separate patrol has also its own colors and "totem" name, such as wolf or eagle. Each patrol has its own peculiar call, representing if possible the patron bird or animal. In this way scouts

of the same patrol may communicate with each other when in hiding or at night. It is not considered honorable for a scout to use any patrol call except his own.

Aside from the scout master and one more commissioned assistant, the troop officers are the senior patrol leader (an optional office), who may be a regular patrol leader attached to a patrol or, in the larger troops, an extra boy officer; a scribe

(secretary), and a treasurer (optional office, may be combined with scribe's work or may be a member of troop committee). There may also be a bugler, and if desired color bearers, librarian, custodian, etc., according to the requirements of the troop's constitution.

History of the Movement

Shortly after Lieut. Gen. S. S. Baden-Powell had worked out his Boy Scout organization in England, in 1908, a group of men interested in boys and the eternal "boy problem" met to discuss the feasibility of founding an American branch of Scouting similar to that worked out in England, but adapted and modified to fit American conditions, needs, and ideals. The result of this meeting was the organization of the Boy Scouts of America. It was incorporated Feb. 8, 1910, and was authorized by an act of Congress in June 1916. At present it is the largest boys' club in the world, having an active membership of about 500,000 boys and men, as well as an associate membership of over a million.

The movement was founded on the broadest possible foundations so as to meet the need of every kind of boy, irrespective of party, creed, race, or environment. It recognizes, however, the importance of religious training for young boys, insists upon reverence and duty to God, and recommends that troops be formed in connection with churches as one of the most satisfactory bases of organization.

It is the plan of the organization, indeed, to serve not as a substitute for other natural agencies of boy training—such as the church and school and home—but to supplement and reinforce these agencies in every way. It is the universal verdict of those associated with these

A FIREPLACE IN A CAMP



The boys that built this fireplace had evidently studied the Boy Scout Manual on Masonry to some purpose. This is the camp of the scouts of the Congregational church in Waterbury, Vt. The camp is a two-mile hike south of the town. Everything is fitted up as neat and convenient as you please, with tables, chairs, cooking utensils, and tableware.

troops that the institution with which the troop is connected is invariably greatly benefited by having at its command the most popular and most practical as well as the most ideal system of juvenile education yet invented.

That the scout movement is worth promoting and encouraging goes without saying. The nation-wide Boy Scout Week, established in 1919 by the proclamation of President Wilson, spread the truth about Scouting and the reasons for supporting it from ocean to ocean. The public can scarcely spend its dollars or its enthusiasm on a better cause than on making Young America clean, fit, "prepared" for the future in every way. Leaders especially are needed to meet the increasing demand of the boys themselves for the privileges and pleasures of scouting. Men are needed to serve as scout masters and assistant scout masters, troop committeemen, and local council members. Any man who is interested either in becoming a scout leader himself or in helping to organize troops should apply at once to local or national Scout Headquarters.

Useful books are: 'Scout Handbook for Boys', published by the Editorial Board of the National Council; 'Two

Little Savages', by Ernest Thompson Seton; 'The Boy Problem', by W. B. Forbush; 'First Aid to the Injured', edited by the International Committee of the Y.M.C.A.; 'Camping and Woodcraft', by Horace Kephart; 'Emergencies', by C. V. Gulick; 'The Boy Pioneers', by Dan C. Beard; 'The Handbook for Scout Masters', published by the Editorial Board of the Boy Scouts of America; 'The Coming Generation', by W. B. Forbush; 'Boy Training', by John L. Alexander; 'Boy Life and Self Government', by George W. Fiske. For full bibliography on scout work and the different phases of scouting see the appendix of the different publications and handbooks of the Boy Scouts of America.

BRAHMA. An Indian deity of the ancient Hindu religion. Brahma is thought of as the creator of the world and the first member of the Hindu Trinity, which includes Vishnu the preserver, and Siva the destroyer and reproducer. In art he is represented with four heads and as many arms. In the Rig-Veda, one of the great religious books of the Hindus, dating from more than 1,000 years before Christ, the name Brahma represents the essence of the universe, from which all created things are evolved and into which they return. The term Brahman still denotes a member of the sacred priestly caste among the Hindus. (See Hinduism; India.)

The EVERLASTING WONDER of YOUR BRAIN

BRAIN. The most baffling mystery of the human brain is how it acts; the next most baffling is its history.

In the development of life the first impression of the outer world came, naturally, to the outer cells of living creatures, and we find that the entire nervous system of the animal world has developed from these outward cells. At a very early stage in the history of a human being a portion of the outer skin turns inward, becomes inclosed in what is to be the strongest part of the body, and develops into the nervous system, the seat of intelligence.

And this nervous system, which man shares with his rivals in the animal kingdom, has developed in man in such a way that we have now *two* nervous systems combined—the old one, which may almost be said to have remained to look after the *body*, and a new one, which chiefly is the mechanism of the *mind*.

When the backbone was built up by the animal world the nerve cell came in too; it was almost, we may say, as if life knew what was coming with the backbone. The old system led to the old animal brain, over which the new brain has crept; and the new brain of man, creeping higher and higher above the old, is the newest and most astonishing creation known to us.

Every Man's Recording Angel

Inside the long tube in what we call the backbone, floating in a fluid so that knocks do not harm it, is a band of 18 inches of soft material, weighing an ounce or two, and measuring less than an inch across. It is

MAN'S Brain, with its greater weight and more delicate organization, raises him above the beasts and gives him mastery over the world. The wonders of its structure and its work are described in this article.

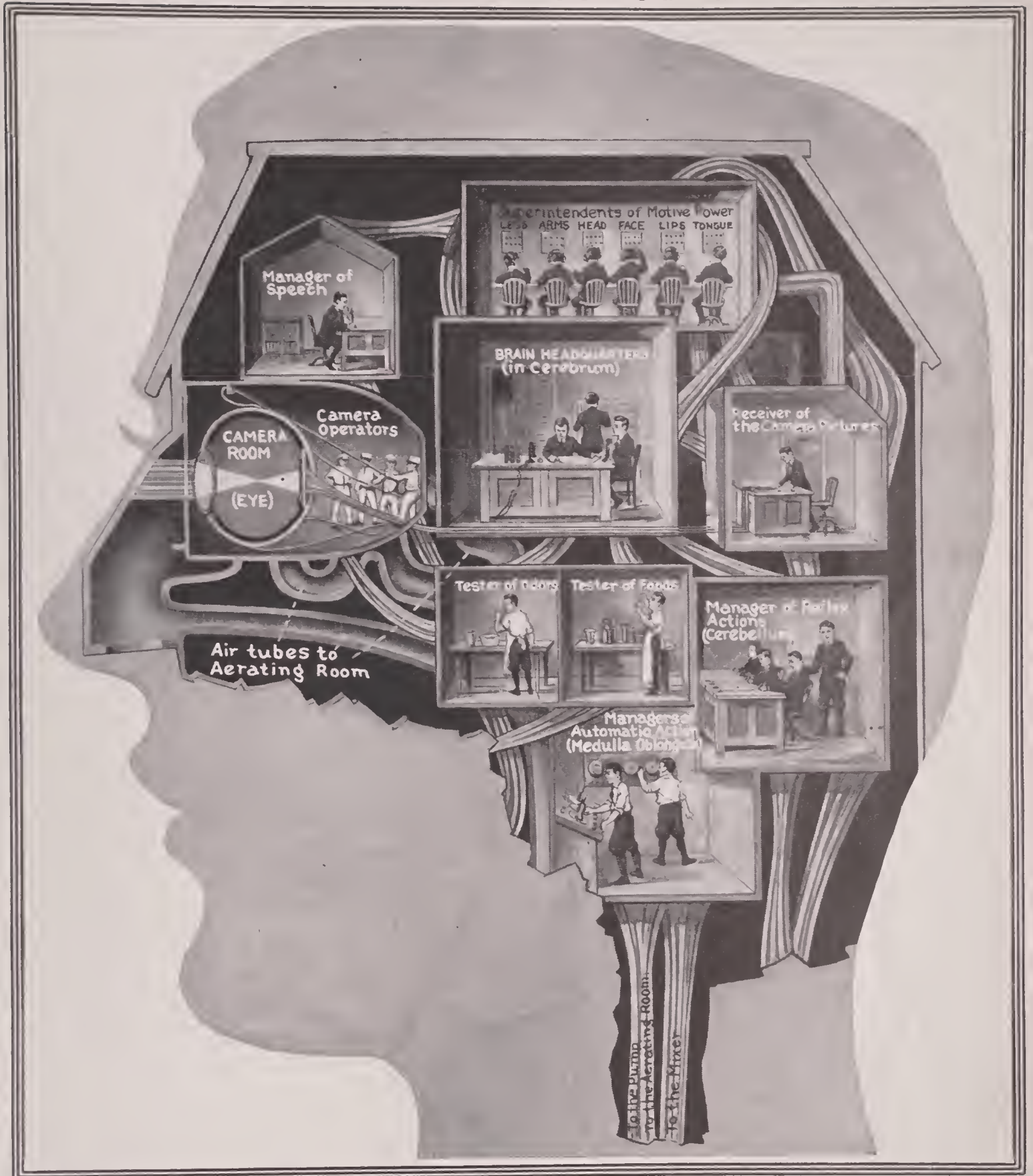
the spinal cord, with thousands of millions of threads running through it up to where the long tube opens out and be-

comes the cranium. In this cavity of the skull, floating in water to protect itself from shock, lies the wonder of the age—every man's book of his own life, every man's library of thought, every man's diary of his acts for every hour he has lived! Here, in this box as strong as a rock, lives the recording angel of every man, writing his life down in indelible characters, missing nothing, forgetting nothing, recording forever, for us or against us, the things of our lives that we and God alone can know.

Not many ounces the brain weighs, and its gray matter is only a fraction of the whole—folded over and over to give it a larger surface, packed with at least 3,000,000,000 cells, which send out their fibers, like telephone wires, to be in instant touch with any part of your body. Like fine thread, less than a thousandth-part of an inch thick, these fibers, running to the brain from the spinal cord, have three separate parts—outer sheaths for protection; inner sheaths made of a fine white substance; and, inside these, wires of thought and action along which the physical basis of every thought that comes into your head, of every impulse of love and hate, of every yearning for noble or ignoble things, of every act that you perform *has* passed, *is* passing, and *will* pass as long as your soul rests in its present home.

Lord Tennyson saw all the mystery of God and man in a "flower in a crannied wall," but how immeasur-

THE CONTROL STATION OF YOUR BODY



Imagine your brain as the executive branch of a big business. It is divided, as you see here, into many departments. Seated at the big desk in the headquarters office is the General Manager—your Conscious Self—with telephone lines running to all departments. Around you are your chief assistants—the Superintendents of Incoming Messages, such as Vision, Taste, Smell, Hearing, and Feeling (the last two hidden behind the central offices). Nearby also are the Superintendents of Outgoing Messages, which control Speech and the movement of Arms, Legs, and all other parts of the body. Of course, only the most important messages ever reach your office. Routine tasks, such as running the heart, lungs, and stomach, or supervising the minor details of muscular work, are carried on by the Managers of Automatic Actions in the Medulla Oblongata and the Manager of Reflex Actions in the Cerebellum. All other departments form what the scientists call the Cerebrum. Suppose that you are walking absent-mindedly on the street, and meet your friend Johnny Jones. He calls your name, you stop, say "Hullo!" and shake hands. It all seems very simple, but let's see what happened during that time in your brain. The instant Johnny Jones called your name, your Hearing Manager reported the sound, and your Camera Man flashed a picture of him to the camera room. "Watch out!" came the signal to your desk, and at the same instant both messages were laid in front of you. As quick as lightning, your little office boy, Memory, ran to his filing case and pulled out a card. The card told you that that voice and that face belonged to a person named Johnny Jones and that he was your friend. Instantly you began issuing orders: "Tell the Speech Manager to say 'Hullo, Johnny' for me! Tell the Leg Superintendent to stop walking at once! Tell the Arm Superintendent to stick out my hand right away and take Jones's hand! Tell the Face and Lip Superintendents to give this man a good big smile!" In less than half a second all your orders were faithfully carried out. Think how much work is done in your brain office every 24 hours!

contained in the Easy Reference Fact-Index at the end of this work

ably beyond all that is the mystery of these few grains of gray matter that have changed the world! These cells that know everything—how do they know? These threads that carry to the brain a child's joy in a babbling brook, a soldier's thrill in the hour of victory, a murderer's dread purpose when the sun has gone down—how do they work? This brain, that gives us all we know of light and sound, yet lives in darkness and silence forever—what unknown power lies hidden here to appal the men who try to understand it?

The sound of a voice does not reach your brain, yet the brain interprets my words for you, and reproduces for you every sound. We see with the mind, as a great artist sees his pictures still if he goes blind. We hear with the mind, as Beethoven heard his symphonies when he was deaf. The memory of the vision, the memory of the sound, are there, and come back when we will. No ray of light ever reached your brain, yet the brain is provided with an agent to look out upon the world and tell you what is there. Like Noah's dove, the nerve of vision comes out of darkness to peep through the window of your house and report to the brain what it sees. It waits behind the window until light has pierced the retina and upon it has photographed the world. Every great and little thing you see about you light impresses on the million fibers of the optic nerve, which carry information concerning the picture to the interpreter who has never been to the window in his life, and sits directing human vision from a throne of darkness.

The Mystery of the "Gray Matter"

In this gray matter lies the mysterious power of man to rule the world; this it is that Nature has given to man in larger amount than to any other animal. It is "the difference that makes the difference" between ourselves and all other forms of life upon the earth. Yet this unspeakable gift to man is not merely the highest achievement of creation; its greatest wonder is that it is creative in itself. It can be trained and developed; it can be guided along wise or foolish ways; and as far as we know, there is no limit to its power. It was said of Oliver Goldsmith that he "wrote like an angel and talked like Poor Poll"; and the marvel of the brain is that its power lies in selected areas, some of which may be rich and some poor, some vigorous and some feeble, so that a man actually may be clever in some things and dull in other ways. It is for us to see that this solemn seat of power, this unfathomable source of energy, this instrument with potentiality beyond our dreams, is rightly trained and guided.

It is not for nothing that there has run through all the ages the great purpose which fulfills itself in the human mind. Fire-mist to earth, chaos to cosmos, a living cell in the sea to the animal world, the adaptation of the earth to human life, the dawn of consciousness and the human mind—these things are not an accident, nor are they the mere working of the laws of chemistry. It is not an accident that stone rises

on stone until the Washington Monument is made; the things that make an airplane did not merely happen to fall together. The mind of man has not yet fallen so low as to believe in that. In spite of overwhelming odds, the mind of man has discovered the history of itself and the hidden workings of the law of life. If we look back into the past and think of the great book of human knowledge that men have built up in these last few hundred years, we are staggered to think how great it really is.

Reading the Book of the Past

The chances against this book of knowledge were millions of millions to one. What evidence of the past is left for us to see? A few stray leaves swept into lakes and preserved in mud, a few flies in amber, a few skeletons in river-beds, a few remains of creatures once living in the sea. No destruction could be more complete than the destruction of the signs of life in ages past. Of the hundreds of kinds of animals and plants in the coal-making period, most were entirely blotted out; and again and again general disaster has thus come upon the earth. Yet somehow, in unimaginable ways, this amazing mind of man has read the tale of the past and torn aside the veil, so that we know what happened, and how it happened, almost as clearly as we know the history of the airplane or the growth of the United States.

There is something almost too great for words in the wonder of the human body, but the wonder of the body itself is not unmatched in the world. We can hardly pick a daisy, or watch a horse galloping, or listen to the singing of a bird, without being stirred by the same mystery, the same feeling half akin to fear, that comes as we think of the human body. Something of this wonder is in every flower that grows and in every animal that walks the earth; but we think of all this other wonder, of all the glory of the world about us, the sun by day and the stars by night, the majesty of the sea and the towering peaks, and we know that the human mind is greater than it all. Nothing known to man can match the wonder of his brain.

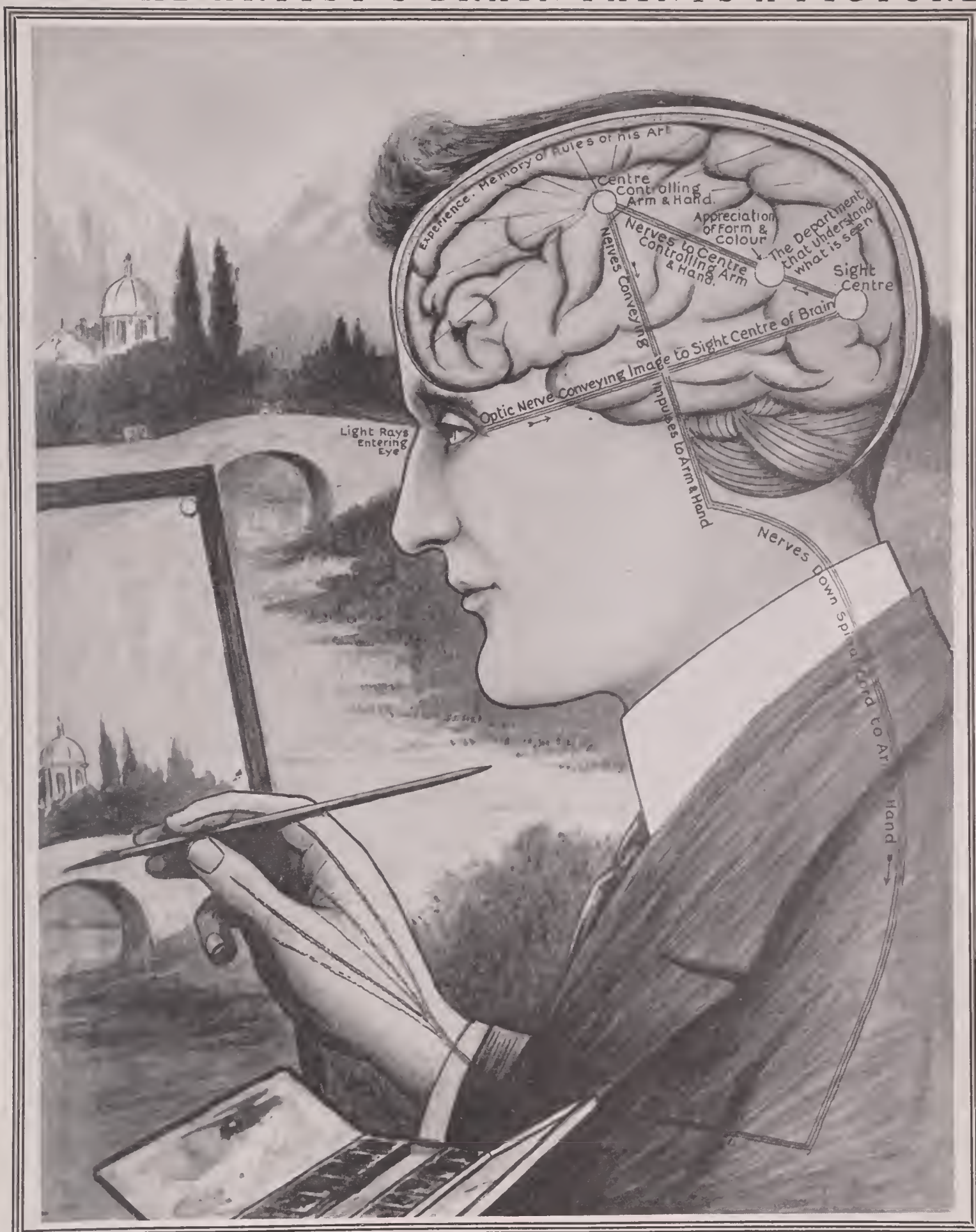
From the life-cell of a bird may grow a bird, but the bird builds its nest and sings its song, and is gone. From the life-cell of a dog may grow a dog, and the dog may love its master and die for him, but it leaves no mark behind, and it never knew the history of itself. But the human life-cell grows into a child, the child is named George Washington, and lo, the United States has come into the world.

Man Rules the World by His Brain

That is the mark of man. Fearfully and wonderfully is his body made, but in this he is not incomparable. He has made himself erect, has come down from the trees and has changed his front feet into hands; but with even these advantages a man would be helpless against the beasts, if it were not for his brain.

Man's hand is beyond compare; with his thumb he has built up human history, and thousands of

HOW THE ARTIST'S BRAIN PAINTS A PICTURE



Perhaps you have thought that the clever fingers of the painter should get the credit for a beautiful masterpiece. But here we see how the picture is first painted in the brain and then transferred to the canvas by that well-trained servant—the hand. As the artist sits down before his easel, the picture of the landscape is photographed through the lens of his eye upon his retina. There the image is picked up by the sensitive ends of the optic nerve and conveyed back to the sight center of the brain, where it is registered. So far, everything is mechanical, just as a new-born baby's vision is mechanical, for while it can see as well as the artist, it cannot *understand* what it sees. But now the mental image of that landscape is carried to the intelligence center, where its colors and shapes, its distances and perspectives, are interpreted and given a meaning. That meaning is telegraphed on to the controlling center of arm and hand. There the artist calls upon his experience and the memory of the rules of his art to give new shape and color to his picture-thought. He really paints it in his imagination, and then sends the details one by one down the nerves to his hand, which puts them on the canvas.

contained in the Easy Reference Fact-Index at the end of this work

books could not hold the things he has learned from the sensitive touch of his finger-tips; but without his brain behind it, a man's hand could never have fought a lion and killed it. In nothing physical but his brain—the organ of his mind—is man superior to animals. Physically many animals are more than his peers, but in his mind man is king of them all. Here alone he towers above the whole known universe.

For all other creatures "Thus far and no farther" has been the law of life; it is man alone who advances. In other creatures the body is the end; in man it is the means. Somewhere in this wondrous frame of a human being was set a seed from which man has built up age after age of glory not unworthy of the glory of the earth. He has made the earth a house for mankind, not less marvelous in its way than the house his soul inhabits.

Other creatures adapt themselves to the world; man does this too; but he does more: he adapts the world to himself. Other creatures are adapted to one or another kind of life—to walk or fly or swim; a man can do all these things. Other creatures have advanced along a single road, and that a *cul de sac*; man is established on the open way that knows no end. It is with his brain that he has marched thus far; it is with his brain he will go farther yet.

From now till the end of our lives we could sit and read of the wonder of our brain and not exhaust the story. If in place of this mysterious power within our frame we had a conscious partner all through life, knowing us thoroughly, intimate with all our moods, understanding all our needs, able to control us and direct us, we should not be the better for it; he could do no more. One can truthfully say: "I am my brain."

Structure and Working of Our Brains

In the brain we find the headquarters of the body, or the "executive offices" of the body, which direct, control, and supervise all of our activities, both within and without. It is here that information is received from the outside world, classified, and stored up in the memory. It is from this headquarters that orders go out, directing all of the activities of the body.

The brain is a vast collection of nerve cells and their long, fine extensions known as fibers, lying mostly within the skull. It has been called the organ of thought, sensation, and conscious movement. Because of its extreme importance and its delicacy, special care has been taken to make the walls of the room that it occupies very hard and not easily injured. This room is called the *cranium*.

The great difference between man and the lower animals lies in the greater weight and complexity of man's brain. The higher we go in the scale of animal life, the more complex does this collection of nerve cells and nerve fibers become. The relative size and surface of the different parts change from the nearly

smooth surface of the brains of the rabbit and bird, up to the dog, whose brain begins to show ridges called "convolutions." In the human brain these convolutions are numerous and very highly marked. The weight of the brain does not necessarily mean greater intelligence, but the number and complexity of the convolutions does so.

The entire nervous system—composed of the brain, spinal cord, and the associated nerves—has been well compared to the complex telephone system. The brain corresponds to the great central exchange, in

charge of an unseen operator, the mind. The various sub-stations or branch exchanges correspond to the groups of nerve cells or nerve centers located along the spinal column. The nerve fibers correspond to the wires—one set, known as the sensory nerve fibers, for "incoming messages," and the other set, known as the motor nerve fibers, for "outgoing messages."

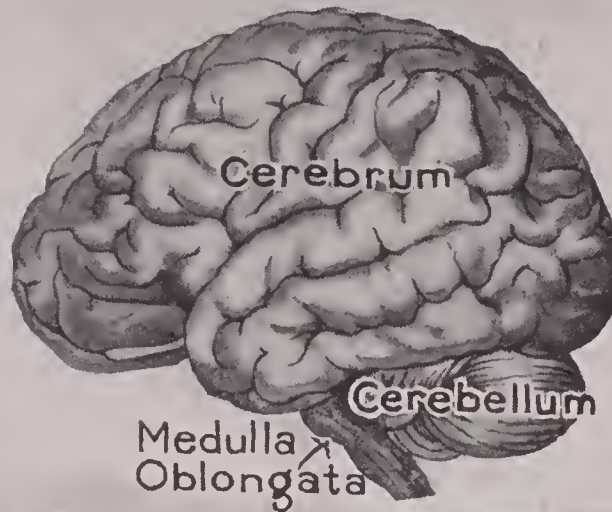
Why You Jump when You are Burned

The two systems, the nervous system and the telephone system, work very much alike. For example, the hand comes into contact with a hot stove and what happens? Instantly the touch corpuscles (or touch cells) located in the hand start a message to the brain over sensory fibers. There it is received and another message immediately started out (over motor fibers) to the muscles which control the hand. And the hand is taken out of harm's way—all done unconsciously and almost instantly.

Where the nerve cells are grouped together in large numbers they show a grayish color and hence are called the "gray matter." Where the fibers predominate the color is white and hence this is called the "white matter." In general the nerve cells are distributed over the outside of the brain, forming a very thin layer which dips down into the convolutions and covers the white matter underneath.

Let us look a bit closer at this central exchange. Just as in a city telephone system the downtown exchange takes care of the downtown district only, and the west side exchange takes care of a west side area only, so in the brain certain areas must take care of certain things and those only. For example, in the "front brain" (*cerebrum*) are located the areas of

CHIEF PARTS OF BRAIN



The Cerebrum or hemispheres of the brain is the part which governs the intelligence. The Cerebellum or "little brain" seems to co-ordinate the muscular movements. In the Medulla Oblongata, which connects the brain to the spinal cord, are centered the nerves controlling the automatic movements, such as heart-beats, etc.

vision, hearing, and speech, also areas for control of voluntary motion; while the "little brain" (*cerebellum*) controls the coördination or working together of the muscles.

Men have experimented on animals, and they have also taken the brains of persons who have died and cut them into minutely thin slices called sections—as many as 2,000 sections through a single brain. They have mounted these sections on glass slides, and have studied them carefully under the microscope. Almost every single cell which goes to make up this wonderful switchboard has thus been examined under the microscope again and again. It has been studied and watched singly and in its relation to its neighbor, and in this way a great deal has been learned about the brain. Much also has been learned by studying the brains of people who have died from brain diseases and by studying the brains of animals.

Parts of the Brain

In men the average weight of the brain is 48 ounces, and in women about 43 ounces. It is made up of two main parts. (1) The "front brain," or brain proper, is called the *cerebrum*. It is divided into right and left portions (called "hemispheres") by a deep lengthwise fissure or groove. These two hemispheres are joined near the middle by a broad band of white or nerve fiber tissue. The activities of the mind—thought and reason, memory and will, sensation or feeling—are located in this portion of the brain. A frog which has lost this part of its brain can still perform a large number of mechanical acts in response to *stimuli*,—can jump, swim, croak, guide itself by sight, and do almost everything a normal frog would do, except the spontaneous acts guided by what we should call an idea. In the human brain certain functions—speech, movements of leg, arm, head, face, etc.—have been accurately located; but we are still far from sure as to just what areas are given over to other activities. (2) The "little brain," or *cere-*

bellum, is situated behind and almost beneath the cerebrum; indeed it is partially overlapped by it. The functions of the cerebellum are not fully known, but it is certain that it is connected with walking and the act of balancing and other adaptations of the body to space relations. (3) In addition there are

various other parts of the brain which have been separately named—such as the "bridge," or *pons*; the *medulla oblongata*, or "long marrow," which is an extension of the spinal cord; and the *pituitary body*, a small rounded gland near the center on the underside of the brain (see Gland).

It is curious to find that the nerve fibers leading from the hemispheres cross at the base of the brain, so that it is the *left* hemisphere which controls the *right* half of the body, and *vice versa*. Most people are "left-brained," that is, all delicate operations requiring skill of the hand are di-

rected by the left brain; hence they are right-handed. "Left-handedness" exists where this arrangement is reversed and the right hemisphere of the brain is the more highly developed.

We must also note that the brain is not a solid mass as we often think of it, for there are cavities in the hemispheres—known as "ventricles"—which are a continuation of the central cavity of the spinal cord. Like the latter they are filled with a fluid called the "cerebro-spinal fluid."

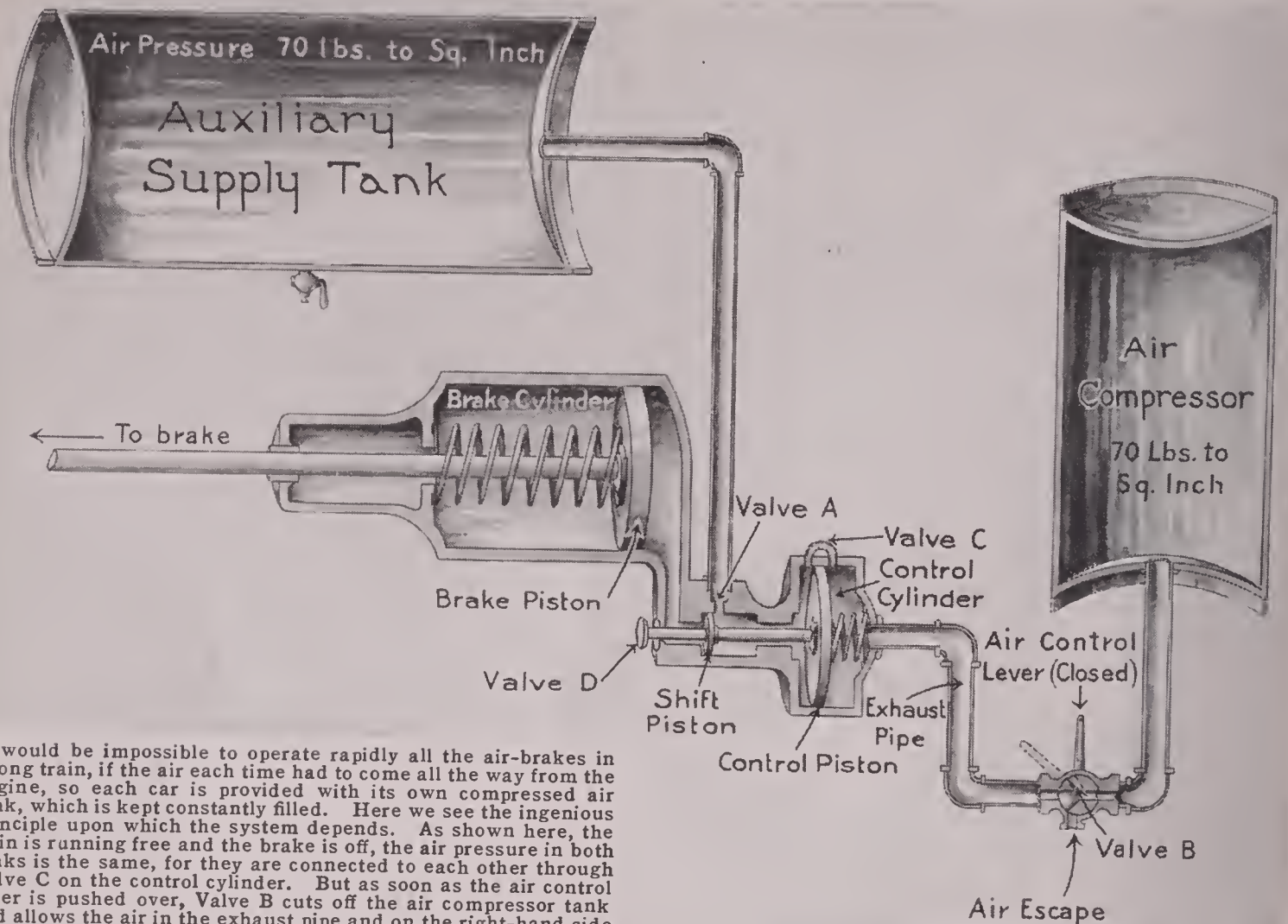
The more we study this brain of ours, the more we realize what a wonderful piece of machinery it is; how delicate the whole of it is, and how absolutely interdependent the parts are! Any injury to the brain, such as may be caused by an accident or disease, will interfere with the physical and mental activities of the patient, according to the part of the brain affected. *Apoplexy* or "stroke" is due to the breaking of a blood-vessel in the brain and comes on unexpectedly. The outflowing blood causes pressure on particular parts, which produces a heavy stupor. This usually passes off, but there are permanent defects from such an injury. One result may be *paralysis*, or the loss of the power of movement, in whole or in part, which may also be caused by other injuries to the brain. Usually the paralysis is on one side only, and it is known that injury to one side of the brain causes paralysis on the opposite side of the body,

THE INSIDE OF THE BRAIN



In this cross-section of the head we see, first, the scalp, then the thick bone of the skull which protects the delicate brain cells, and, inside the skull-case, the complicated "convolutions" or folds of the brain itself. The "gray matter" and the white fiber masses are indicated by the dark and light shading. Notice how the nerve strands from the right and left hemispheres cross at the bottom of the brain. This explains why an injury to the *right* side of the brain may paralyze the *left* side of the body, and *vice versa*.

HOW A BLAST OF AIR STOPS A TRAIN



It would be impossible to operate rapidly all the air-brakes in a long train, if the air each time had to come all the way from the engine, so each car is provided with its own compressed air tank, which is kept constantly filled. Here we see the ingenious principle upon which the system depends. As shown here, the train is running free and the brake is off, the air pressure in both tanks is the same, for they are connected to each other through Valve C on the control cylinder. But as soon as the air control lever is pushed over, Valve B cuts off the air compressor tank and allows the air in the exhaust pipe and on the right-hand side of the control piston to escape suddenly. Before any great quantity of air can run out through Valve C, the pressure on the left side of the control piston forces this piston to the right, closing Valve C. This pulls the shift piston across Valve A, closes Valve D, and allows the air from the auxiliary supply tank to run into the brake cylinder and drive home the brake piston, bringing the car to a stop. With this method of applying the brakes by letting air out from the connecting pipes, a car or any part of a train which breaks away from the engine is at once brought to a halt.

owing to the crossing of the fiber tracts. *Aphasia* is the loss of the power of speech, or the power to understand what is said, and *amnesia* is the loss of memory. These mental disorders may appear as a result of disease in or injury to the corresponding part of the brain, in persons who otherwise appear perfectly well. *Insanity* too is now known to be a disease of the brain, and such patients are now placed in hospitals for observation and care in order that physicians may find out how to cure their sick brains.

BRAKES. Cornelius Vanderbilt, the railway magnate, fixed a quizzical gaze on George Westinghouse, the inventor.

"Do you mean to tell me," said he, "that you can stop a railroad train by *wind*?"

"Well," replied Westinghouse, "since air is wind, yes!"

"Nonsense!" exclaimed Vanderbilt. "I have no time to waste on such a fool idea!"

And the inventor, discouraged but determined, was obliged to look elsewhere for aid. Eventually he found it. Other men of wealth, among whom were Andrew Carnegie, Ralph Bagley, and Robert Pitcairn, recognized the merit of his invention and equipped a train according to his plans. As the old-fashioned train rattled over the rails near Pittsburgh, the first trial of the air-brake took place in 1868.

The test was a complete success. Westinghouse had made good his boast that with this automatic air-brake he could stop a train in its own length—stop it almost as abruptly as the sea-gull, swooping down from on high, checks its descent with tail and wings and settles gently on the water.

Almost immediately the Westinghouse brake replaced the old hand-brakes on all fast passenger trains in this country and the rest of the world. Later it was applied to freight trains and trolley cars, so that today the once familiar picture of the brakeman struggling with frantic vigor at wheels and levers is seen no more, except on a few unimportant lines which still operate with their old equipment.

Without the air-brake, the terrific speeds of modern trains would be impossible. Even with the light trains and low speeds of the early days many accidents were caused by the ineffectiveness of the hand-brakes. It was largely the sight of such an accident that set Westinghouse experimenting to devise a brake which could be applied effectively and at about the same instant to every car in a train.

He succeeded so well that the action of his air-brake takes place at the last car of a 50-car train in

$2\frac{1}{4}$ seconds after application at the engine. The Westinghouse brake is operated by a steam-driven air pump on the engine, which compresses air into a reservoir. A system of pipes and couplings distributes the compressed air to the brake cylinders placed under each car.

And thus today, as one writer says, "while the locomotive thunders along the steel highway at great speed over chasms spanned by trceries of steel and down steep mountain grades, the engineer sits calm and steadfast, secure in the knowledge that locomotive and train are entirely in hand, since a turn of a lever will cause every wheel to be gripped by viselike brakeshoes applied by the greatest life-saver of modern times, the Westinghouse automatic air-brake."

Devices for checking speed have been used ever since men first invented wheeled vehicles. They all depend on friction. The simplest and probably the most primitive method is to lock one or more wheels by a chain fastened to the axle, when going down hill. The next step is to

attach "shoes" of wood or metal so that they can be applied to the rim of the wheel by pressure of the foot on a lever. Then comes the invention of more effective means of applying these brakes—by the use of springs, hydraulic pressure, electro-magnetism, compressed air, or vacuum. In most modern elevators in buildings the brakes are operated by powerful springs, which press metal shoes against a brake pulley at the top of the elevator shaft. Most automobiles are equipped with two sets of exceedingly powerful brakes. The service or foot brakes are usually metal shoes which operate by pressing against the inside of a drum attached to the driving wheels, while the emergency brakes are steel bands which are clamped tight around the outside of the drum.

One of the most ingenious brakes is the "coaster-brake" for bicycles, which enables the rider to stop by back-pedaling. Some bicycles, however, are equipped with brakes which work on the rims of the wheels and are operated by levers attached to the handlebars.

BRASS. An alloy of copper and zinc much used in the arts because of its handsome yellow color and the ease with which it can be worked. (See Alloys; Copper.)

The MYSTERIOUS LAND of the AMAZON

BRAZIL, UNITED STATES
OF. The enormous republic of Brazil, which occupies more than half of all South America, is a fascinating region to the explorer because of the vast proportion of its territory which has never been trodden by civilized man. Along the lowlands of the mighty Amazon, which with its 200 tributaries forms the world's largest river system, stretches the greatest continuous forest of the two hemispheres (see Amazon River). This vast basin, comprising more than one-half of the area of the republic, is flooded every year throughout much of its extent, and hence is covered with a vegetation more luxuriant than is found in any other part of the world.

The Great Forest and Its Zoo

The giant trees rise from impenetrable thickets of underbrush, and their branches are entwined and festooned with great creepers and vines, themselves as big as trees. Innumerable species of bright-plumaged birds fill the jungle with their harsh strident cries. Huge alligators, boa-constrictors, anacondas, and rattlesnakes infest it; and it is the home of monstrous spiders large enough to prey on birds; of brilliantly colored butterflies, some of them nine inches from wing-tip to wing-tip; of immense numbers of monkeys, of savage pumas and jaguars, and of such strange beasts as the armadillo, sloth, peccary (or wild pig), tapir, and ant-eater.

This abode of mystery, the largest unexplored tract in the Western Hemisphere, every year lures bold adventurous spirits, but few have penetrated

Glimpses into the World's Treasure-House of Coffee and Rubber

Extent.—East to west, about 2,700 miles; north to south, 2,600 miles; area, about 3,292,000 square miles (larger than the United States, excluding Alaska). Population estimated at from 24,000,000 to 27,000,000.

Chief Rivers.—Amazon River, with its great tributaries, the Japura, Rio Negro, Jurua, Purus, Madeira, Tapajos, Xingu, and Tocantins; Araguaya, Paraguay, São Francisco, Parana, and Uruguay. (A tributary of the Madeira is called Roosevelt River in honor of ex-President Roosevelt, who explored it in 1913.)

Chief Products.—Coffee, rubber, sugar, hides, yerba maté, cacao, tobacco, cotton, frozen meats, cotton goods.

Chief Cities.—Rio de Janeiro (capital, population about 1,500,000), São Paulo (450,000), Bahia (350,000), Pernambuco (250,000).

far and many have died in the attempt. Trails cut painfully and laboriously are swallowed up within 12 months by the ocean of vegetation so that hardly a trace remains.

In many other respects Brazil is unique among the countries of

the world. The third largest political division of the American continent, with an area of about 3,292,000 square miles—nearly as large as all Europe and larger than the United States if we exclude Alaska—Brazil has an estimated population of about 27,000,000, or only a little more than the states of New York, Pennsylvania, Illinois, and Colorado. Its four largest states have an average population of only one person to every two square miles, against an average of 30 to the square mile in the United States. The bulk of this scanty population clings to the narrow strip of coast along the Atlantic or to the banks of the Amazon and its tributaries.

A Great Treasure-House Still Unopened

"No great country in the world owned by a European race possesses so large a proportion of land available for the support of human life and productive industry," says Lord Bryce in his 'South America'; yet the immense resources of Brazil have hardly been touched. With only a small fraction of its fertile land under cultivation, Brazil today produces two-thirds of the world's supply of coffee (see Coffee) and three-fifths of the world's rubber (see Rubber). The Amazon forests abound in mahogany, rosewood, ebony, and cacao trees, and others which yield valu-

able drugs and nuts. Over the vast grasslands of central and southern Brazil range enormous herds of cattle, almost half as many as in the whole of the United States; yet the packing industry is only in its infancy. The agricultural possibilities of the country are immense. The climate and soil are unsurpassed for growing cereals, fruits, sugar, cotton, flax, and dozens of other crops. In minerals, Brazil is probably the world's greatest untapped storehouse. Brazil is believed to have the richest and greatest iron deposits in the world; its diamonds are of finer grade than those of South Africa, and it has other precious stones in abundance; more than \$500,000,000

Let us look more closely at the shape and structure of this wonderland. Brazil has a coastline of 5,000 miles fronting the Atlantic Ocean on its east and northeast boundaries. The land frontier touches that of every other South American republic except Chile. In physical formation it consists of two sharply contrasted divisions: a table-land of rolling plains and mountains in the east and south, and the great forest land of the Amazon in the north and west. The extensive coast lands are made up of sand and rock washed down from the high seaboard ranges, covered in many places with dense tropical growths.

For the greater part of the country, the rivers are

the only avenues of communication. Most of the natives live in tiny settlements along their banks in houses set high on piles to avoid the floods. The Amazon in the north, with its 100 navigable tributaries, the Tocantins and São Francisco in the central portion, and the Paraguay, Uruguay, and Paraná in the south, furnish more than 10,000 miles of waterways deep enough for large steamers, and 20,000 miles more open to boats of light draft. Several steamship companies maintain regular service between important points. Along the seaboard and connecting with the larger cities inland are nearly 20,000 miles of railway.

While Brazil lies almost entirely in the tropics and the climate of the greater part is character-

istically tropical, with only five or ten degrees' difference between the seasons, there are temperate regions in the mountains and in the southern portions. Along the Amazon the heat is tempered by the great expanse of water, by the forests, and by the trade-wind which blows up the river almost constantly. But the excessive rainfall and the constant heat breed fevers which

SOUTH AMERICA'S LARGEST COUNTRY



Here you see how the Amazon collects its waters from the vast sweep of encircling mountains and hills, and after flowing through the great forests of northern Brazil, pours into the Atlantic Ocean a greater volume of flow than any other river in the world. The central regions of Brazil are among the wildest and least explored in the world, but boundless wealth there awaits development.

worth of gold has already been mined; and the immense deposits of talc, silver, platinum, lead, copper, manganese, mercury, coal, graphite, and rare marbles have scarcely been touched. The eyes of the world are turning longingly to these various sources of wealth, which only await European and American capital for their development.

For any subject not found in its alphabetical place see information

SHIPPING PORT FOR THE COFFEE BEAN



The city of Santos, on the coast of Southern Brazil, is the most important coffee shipping center in the world. Here are loaded the ships that carry the great Brazilian coffee crop to Europe and to North America. Its harbor, which you see in the distance, is a fine one, protected by surrounding hills. Santos is a typical South American city, with wide pleasant streets, low white houses, and a general atmosphere of busy prosperity.

are dangerous to white men and thus retard development of the natural resources.

What Brazil Sells to the Rest of the World

The chief exports, in addition to coffee and rubber, are sugar, cacao beans, hides, tobacco, cotton, beans, frozen meats, and manganese. Nearly one-half of these go to the United States. More than two-thirds of all the coffee consumed in the world is produced by Brazil, and by what is known as a "valorization" plan the Brazilian government aids the growers and regulates exports so as to keep up prices. Brazil also produces large quantities of *yerba maté* or "Brazil tea"—the dried leaves of the *ilex* tree—which is mostly exported to other South American countries. The beverage made by steeping these leaves is said to taste like a weak mixture of turpentine and water, but it is very popular with the natives.

Manufacturing has been slow in developing, but the textile and meat-packing industries have become of increasing importance in late years. Machinery and most of the luxuries of life are imported from Great Britain, the United States, and Germany.

A Strange Mixture of Races

The population of Brazil is the most mixed on the continent. Of its estimated 27,000,000, the whites probably do not number more than 9,000,000 even with the steady flow of European immigration—chiefly from the mother country Portugal, and latterly from Italy, Spain, and Germany. The remaining

two-thirds consist of negroes originally imported as plantation slaves, but freed by the government in 1888, native Indians, and mixed breeds. Brazil is the only South American republic in which negro blood is an important element in the racial mixture.

The language of Brazil, unlike that of the parts of the continent colonized by Spain, is Portuguese. The standard of literacy is very low, and there is a crying need for education. Primary education is free, but it is not compulsory. In Rio de Janeiro there are high schools and colleges, and a naval academy, for Brazil has an important navy of modern ships.

Under a constitution adopted in 1891, Brazil is a federal republic of 20 states and one federal district, with a government much less centralized than that of the United States. Its capital is Rio de Janeiro, the second largest city of South America (*see* Rio de Janeiro). São Paulo, the world's greatest coffee market, lies in the highlands of the coast about 40 miles from the sea. Its elevation gives it a delightful climate. A network of short railroads brings the coffee from the great plantations which cover the state of São Paulo, and another line carries it to the seaport of Santos, one of the busiest ports of the continent, which ships about 15,000,000 bags of coffee every year. Bahia (São Salvador), the old capital of Brazil, is also an important shipping center for coffee, cacao, and cotton. This city is the home of the seedless orange, and it was from there that the United States Agricultural Department first obtained trees of this variety. Huge elevators connect the commercial part of the city about the harbor with the picturesque residential section on the cliffs high above. Pernambuco (Recife) is one of the chief sugar centers and an important port. Para (Belem) at the mouth of the Amazon is the great rubber

port. Ocean steamers travel from Para nearly 1,000 miles up the Amazon to Manaus, which has become a thriving modern city and shipping port for forest products.

Brazil was discovered in 1500 by a companion of Columbus, the Spanish explorer Pinzon. The same year a Portuguese commander, Pedro Alvarez Cabral, visited the land and took possession of it in the name of his sovereign. Portuguese colonies sprang up, but Portugal had to fight for the land, expelling some French settlers in 1615 and Dutch in 1661. For 60 years, from 1580 to 1640, while Portugal was united with Spain, Brazil received little attention. When the French in 1808 invaded Portugal, the royal family took refuge in Brazil, and during the 14 years of exile did much for the country. When King John returned to Lisbon, the eldest son Dom Pedro was left as prince regent.

The following year, 1822, yielding to a revolutionary movement, Dom Pedro declared Brazil independent and was crowned emperor. After a strenuous reign he abdicated in 1831 to a regency, to be succeeded by his son Dom Pedro II who ruled until 1889. In that year a bloodless revolution finally made the country a republic. From 1865 to 1870 Brazil in alliance with Argentina and Uruguay waged a costly but victorious war with Paraguay.

Brazil severed relations with Germany on April 11, 1917, after the torpedoing by the Germans of the Brazilian steamer *Parana*. Other sinkings of Brazilian vessels by Germany inflamed public opinion until finally a state of war was proclaimed. The powerful Brazilian navy took up the patrol of the South Atlantic, thus releasing many French and British warships for other activities.

The DAILY BREAD of ALL THE WORLD

The Long and Ancient Story of the Bread Loaf, which is also the Story of the Farmer and His Plow, the Miller, the Baker, and the Boy with the Delivery Wagon—Some Quaint Fashions in Bread

BREAD AND BAKING. Bread is rightly called the "staff of life" of the white race, the world over for it is and always has been their most important food. At every meal we want bread, and if we do not have it, no matter what else there is, our meal is incomplete. Did you ever stop to think of the immense quantity of bread that is used every day in this country, and of the millions of people who are needed to grow the grain, grind the flour, make the flour into bread, and bring it to our table? Every person in the United States, it is estimated, eats a barrel of flour a year. Imagine what a mountain this would make! If the barrels were placed end to end they would go around the earth three times at the equator; and if they were piled one on top of another they would reach a quarter of the way to the moon! And it takes five bushels of grain to make a barrel of flour. An acre of ground yields on the average less than 20 bushels of wheat—which is the grain from which most of our flour is made—so you can readily figure out what an immense area must be planted to wheat to supply the needs of the United States alone. Consider how much work the farmer expends in growing this grain; think of the network of railways all over the country

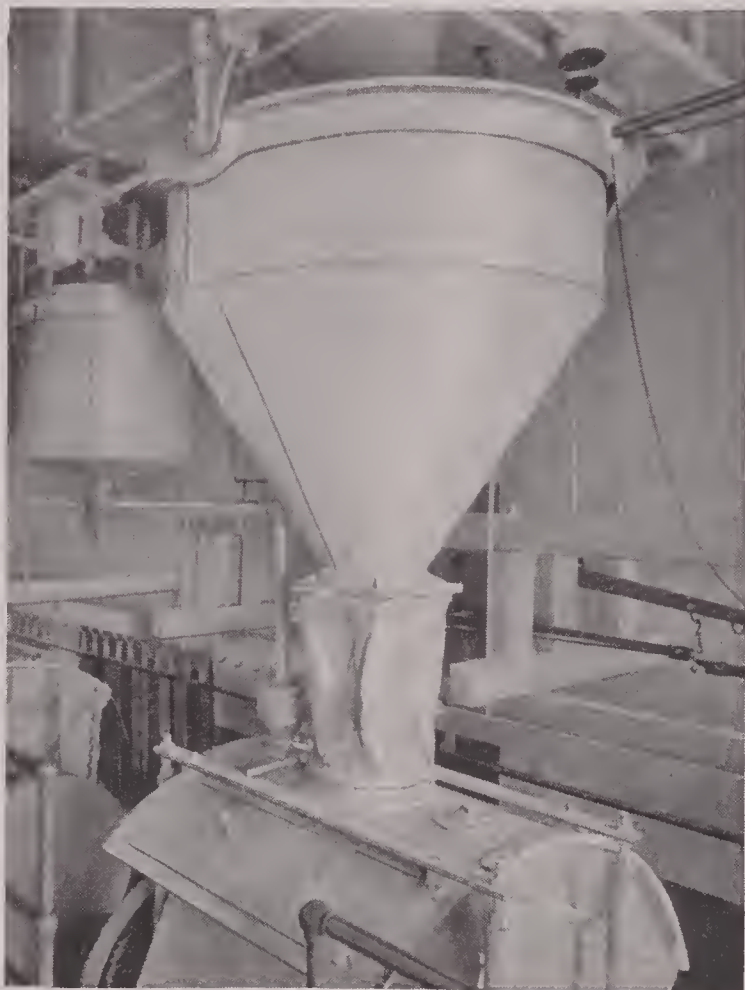
that bring it to the terminal elevators; think of the more than 10,000 great mills that grind it into flour, and the thousands and thousands of bakeries that

bake the bread; and you will see that the story of bread is one of the greatest and most interesting ones in the world.

Bread has meant a great many things since the world began, but it has always been a cooked mixture of some kind of ground grains and water. Far back in the Stone Age, the earliest age of man that we know anything about, people used to make bread. We know this because hard little burned cakes have been found in their caves, with crude implements for crushing grain. These cakes were made of grain, usually wheat, slightly crushed and mixed with water. They were spread on a hot stone with hot ashes piled on top to cook them. The result was little hard cakes gritty with ashes, and not much like the crusty brown loaves of bread, soft and white within, that we

have today. The people who lived in Egypt 5,000 years ago knew how to bake bread from white flour. They made little rolls about the shape of our muffins, and in Greece and in Rome we know there were public bakeries at a very early date.

HERE IS WHERE THE BAKER'S BREAD STARTS



This machine turns the flour, water, and other ingredients into dough. The funnel at the top drops the materials into the mixer below, where clean steel arms give them a more thorough working than could any human hands.

HOW THE BAKER TURNS DOUGH INTO LOAVES



Following the rule of large bakeries that no hands shall ever touch the material, the dough is worked entirely by machines. The picture above shows two of the ingenious devices employed. Into the two reservoirs on the ceiling dough is dropped from the floor above. You see that wheel with a chain hanging to it beneath the nearest reservoir? That wheel operates a sliding knife, which cuts off portions of the dough and drops them into the hopper beneath. These portions are cut into smaller "loaf-size" lumps, by the machine at the bottom. The lumps then pass to the "umbrella machine" and up the chute which curves over its surface. By revolving against the pieces, the "umbrella" turns them into balls.



The balls turned out by the "umbrella machine" drop into the buckets inside this glass-inclosed "proofer." The buckets are attached to an endless chain, which carries them slowly through the proofer. Heat and moisture conditions are kept just right within the proofer, and when the lumps come out the dough has "raised" for the last time. It is delivered to a molding machine which shapes the loaves and delivers them to the ovens.

contained in the Easy Reference Fact-Index at the end of this work

All the various kinds of bread that people have eaten and eat today belong to one or the other of two principal types—*leavened* or *unleavened*. Leavened bread means *raised* bread—bread that contains *yeast* or some other substance to make the loaf light and porous (*see* Yeast). Unleavened bread does not contain this leavening agent, and as a result is dry and hard throughout. Certain forms of “water crackers” and “hardtack” are examples of unleavened breads. Before man learned to make yeast, a portion of the uncooked dough was left from each baking and allowed to sour. This sour dough mixed with the fresh dough causes the whole to ferment; gas is formed and the bread is raised or leavened. This process is still used in far outlying districts where it is not possible to obtain yeast.

Wheat and rye flours make the bulk of the world's bread, though barley, corn, oats, rice, and potato flour are also used, either single or in combination. Wheat and rye breads are superior to all others in lightness and porosity, because the gluten they contain makes

practice in the Middle Ages, before stores were invented, by which a brick oven was erected in every village and a fee collected by the feudal lord for its use. Even with the modern bakery close at hand, however, there are many families that do their own baking because they prefer the taste of “the bread that mother makes” and believe it to be more nourishing than bakers' bread.

A Visit to a Great City Bakery

In the big bakeries it is most interesting to watch the flour being made into fragrant loaves of bread. Everything about these big modern factories is scrupulously clean and sunlight floods the rooms all day long. From the time the flour is prepared for mixing until the loaves are baked, the work is all done by machinery. First, the sacks and barrels of flour are placed on an electrically operated elevator and taken to the top floor, where the flour rooms are. Here the flour is carefully tested, and various grades are mixed until the special blend the baker uses is obtained. The flour is then sifted thoroughly and

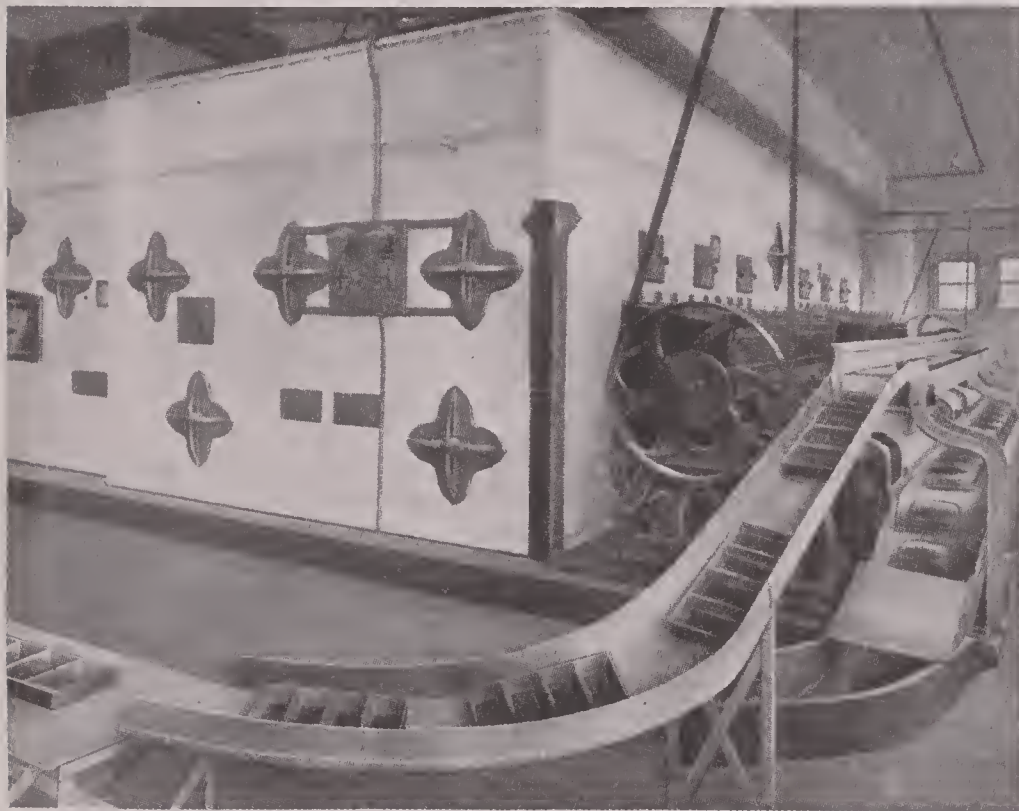
put into big storage bins, ready for use. Just below these bins are the weighing hoppers. When flour is wanted, the scales are set and the flour comes down into the hopper until the required amount has been weighed, when the supply automatically stops. Pure water stored in big tanks, yeast, salt, sugar, and malt extract are added in exact proportions. The mixing is done in machines called “dough mixers,” which hold half a ton of dough each. Steel arms, clean and shining, work back and forth, and mix the dough more thoroughly than could be done in any other way.

How the Bakers “Prove” the Bread

The dough is next emptied into large steel troughs on wheels and taken to a room where the temperature is just right for the bread to rise, or, as the bakers say, “prove.” The bread is left here for several hours and watched carefully. When it has risen to the proper point it goes to the automatic dividing machines,

which weigh out the exact amount needed for each loaf, cut it neatly off, and pass it to the rounding machines. After the dough has been made into balls, it is left to rise a second time, in what is known as an “automatic proofer.” For several minutes it rides back and forth in the carefully maintained temperature of the dough room, and is then formed by the “molding machine” into loaves to fit the pans. It is then trundled away to a room where the tem-

BAKED AT LAST AND READY FOR WRAPPING



The machinery at the right of this great oven turns the baked loaves out of their pans, and sends the pans back along the upper trough to the “panning machine” for further use in baking. Meanwhile the loaves are turned into the lower conveyor at the right. This carries them to the wrapping machine, from which they are loaded into wagons. The ovens themselves are wonderfully adapted to their work. They can be brilliantly lighted inside at any time, and thus the bakers can watch the bread throughout the baking process.

the dough sticky and elastic, thus retaining more of the gas generated by the leavening agent. Bread made from other flours may be made lighter by mixing in a small proportion of wheat flour.

People who live in the country and very small towns usually bake their own bread, but in the larger towns most people get their bread from bakeries where thousands of loaves are baked. This is the universal custom in Europe, where it dates from the

HERE IS WHERE THE SODA BISCUIT GETS ITS START



The manufacture of soda biscuits or "crackers" follows the same general principles as bread making. The big machines shown above are dough-mixers. When the dough is mixed the hopper is tilted forward, and the machinery inside ejects the dough into the little wagons. It remains in these wagons long enough to age properly, and then is taken to the machines which stamp out the cracker shape and prepare it for the ovens.

perature is kept at 100 degrees—several degrees hotter than the dough room—for the final rising.

The ovens in a big bakery are built of brick and the walls are made very thick, so that they hold their heat for a long time. Even a week after the fire has been allowed to go out bread can still be baked in the ovens. Each oven holds from 300 to 350 loaves of bread at a time. There is a powerful electric light inside, so that the interior can be flooded with light when the baker desires to see the bread. The baking takes about 35 minutes. Just before the loaves are removed steam is turned into the oven to make the crust glossy. The housewife gets the same result by rubbing the loaf with butter or with cold water or milk just after it leaves the oven.

From the oven the loaves are carried on an endless chain belt to the bread room. In some bakeries each loaf is wrapped in waxed paper by a machine into which the loaves go as they leave the oven. In factories where the bread is not wrapped, white-gloved workmen pile it in clean crates for delivery.

Although white bread in loaves is by far the biggest product of the bakery, many other wares are made, such as rye bread, graham bread, whole wheat bread, rolls, cakes, pies and pastries.

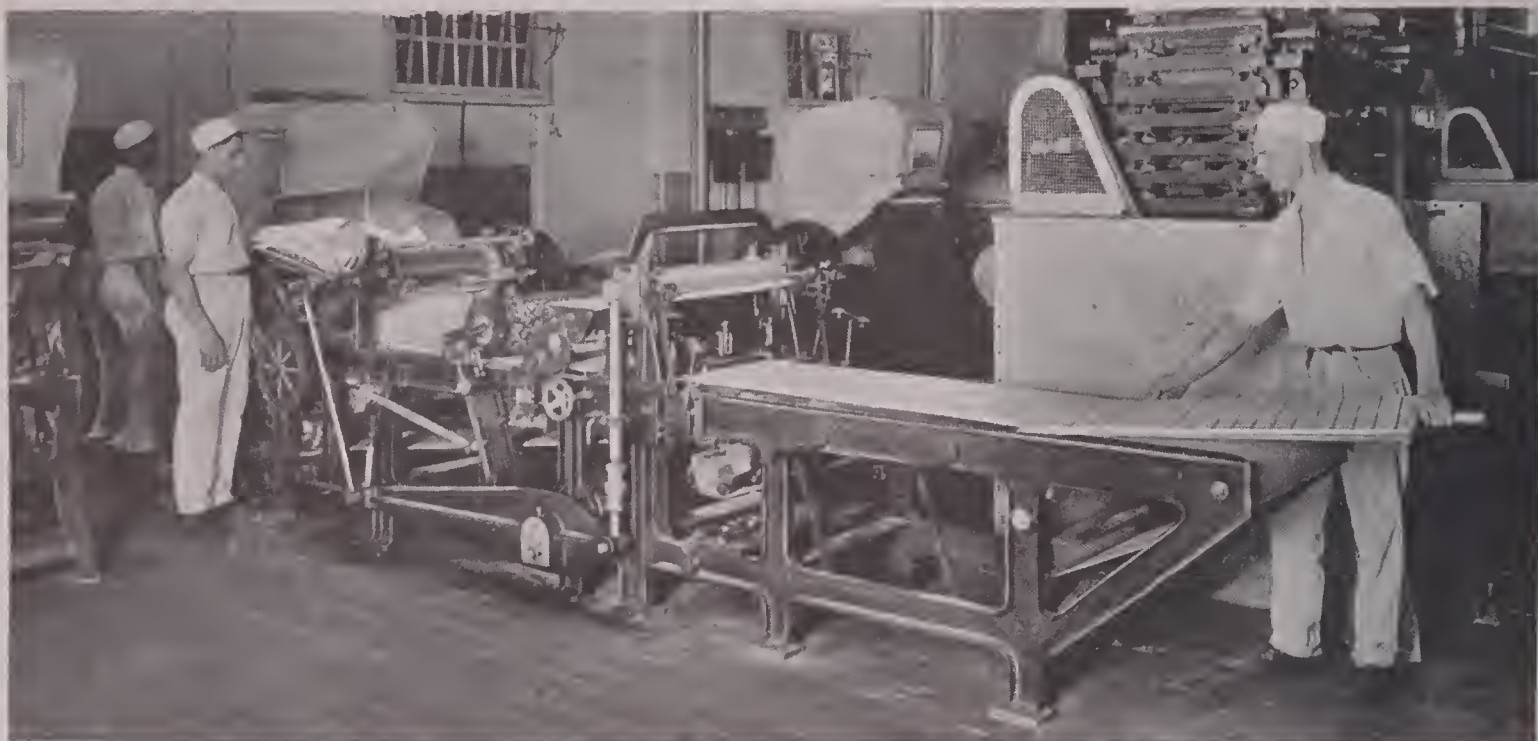
Quite recently chains of bakeries of a new sort have arisen in our cities and towns in which bread is baked in gas-heated revolving ovens, which often are placed in the shop window in full view of the passer-by.

When bread is made at home it is usually mixed and kneaded by hand, sometimes in small mixing machines. Any good cook-book will give a recipe as to the proportions of yeast, flour, salt, sugar, and water to use. After kneading, the dough is left to rise in a warm temperature, kneaded thoroughly again, made into loaves, left to rise again, and baked. Biscuits, cakes, pies, cookies, and doughnuts are all usually made with wheat flour, but baking powder is often used as the leavening agent instead of yeast (see Baking Powder).

The Breads of Various Nations

Various countries have their own characteristic breads. The French lead the world in the quality and variety of their breads. Vienna bread is made in long slender loaves with a heavy crust of a pleasing nut flavor. In Turkey bread is made by mixing a batter of flour and water and baking it on hot rocks. Swedish bread is baked in hard flat round disks. Corn bread is the chief article of diet in many parts of the southern states, and there "bread" means corn pone, wheat bread being called "light bread." Bran bread is made by mixing a part of the outer husks of the wheat with the white flour. In graham and whole-wheat bread almost the entire wheat is ground in making the flour. The "Victory Bread" made in the United States during the World War substituted a certain proportion of other cereals for wheat, to conserve the wheat supply. The "war breads" of

SODA BISCUITS READY FOR THE OVEN



This complicated machine stamps the dough into the squares which are to become "crackers." The squares are then fed out upon trays like the one the baker is taking up at the right, and these trays are placed in the oven.

Germany and other European powers often contained so much inferior food substance as to make them practically indigestible.

Of recent years crackers and biscuits—small thin cakes—have become enormously popular. In France and England all such cakes, whether sweetened or unsweetened, soft or hard, plain or fancy, are known as "biscuits." In the United States, "cracker" usually means a very thin cake baked until it is dry, crisp, and brittle, and the term "biscuit" is applied by bakers to various forms of small sweetened and fancy cakes. Both cracker and biscuit are used, however, as the general term for this whole class of bakery products.

The cracker industry has had a phenomenal growth in the United States since its beginning a little more than a century ago. Today it ranks as one of the best organized and largest industries in the country. The first crackers were large round unsweetened and unleavened cakes, baked until they were very hard, something like the water-cracker of today. Because they kept much better than ordinary bread, they were in great demand for ship supplies and were often called "ship bread." At first they were made entirely by hand, but at the time of the great gold rush to California the demand for this convenient food became so great that machinery was invented to roll the dough and stamp it into cakes. During the Civil War in America the army and navy called for such quantities of this "hardtack," as it was called, that an improved oven was invented which increased the capacity of the bakeries by four or five times. This invention, which revolutionized the cracker industry and is used today in virtually the same form, is called the "mechanical reel oven." It consists of a number of flat pans attached to the arms of a re-

volving wheel, much like the famous Ferris wheel. Some of the large reel ovens today have a daily capacity of 50 barrels of flour.

The other varieties of cracker had also come into use by the time of the Civil War—the familiar "soda cracker" and the soft "butter cracker." These are made from leavened or raised dough, and so are lighter and more palatable than the old type of hard cracker, made from unleavened bread. Presently manufacturers began experimenting with various types of sweetened and fancy biscuits. These soon gained an immense sale which rapidly became one of the most profitable branches of the trade.

Recently the introduction of the sealed package has given another great impetus to the industry. Crackers and biscuits are now put up in cardboard cartons and protected from moisture by a wrapping of waxed paper, thus preserving their crispness and freshness for a much longer time than when they were handled in bulk. Although these package goods reach the consumer in a more attractive and sanitary form than under the old system, he has to pay the price in increased cost.

So prodigious has been the growth of this branch of the baking industry, in the last generation, that giant corporations have sprung up, with great branch bakeries in all the leading cities of the United States. In these bakeries elaborate machines mix the dough, roll it out into sheets and stamp these into plain or fancy forms which hold together until after they are baked. There are also ingenious contrivances for filling tubes of dough with fruit paste or other filling, for icing them, and for doing the hundreds of things necessary to turn out the many appetizing kinds of biscuit now offered us at every corner grocery store. (See Flour and Flour Milling; Wheat.)

BREADFRUIT. The large globular fruit of this tree furnishes the chief food of the South Pacific islands. On various species of the tree the fruit ripens at different periods of the year, thus affording an almost constant supply. The breadfruit tree—of which there are 40 species found throughout the tropical regions of both hemispheres—grows from 40 to 60 feet high, and is often limbless for half this height, with large spreading upper branches. The starchy fruit hanging from short thick stems is about the size of a child's head. It is first green, then brown, and when ripe turns yellow.

The breadfruit is prepared for use in a number of ways. The natives of the South Sea Islands usually gather it just before it is ripe and bake it entire in hot embers. They then scoop out the inside, which when properly cooked is soft and smooth with a taste not unlike boiled potatoes and sweet milk. Another method consists in cutting it into thin slices which are dried in the sun and then baked or made into a flour which is used in preparing puddings, bread, and biscuit. The fruit is kept by storing it in pits where it ferments and becomes sour, but after baking under hot stones, it yields a pleasant food. One author says of it: "With meat and gravy it is a vegetable superior to anything I know either in temperate or tropical countries. With sugar, milk, butter, or treacle it is a delicious pudding, having a very slight and delicate but characteristic flavor, which one never gets tired of."

From the fibrous inner bark of the tree a cloth is made, and from the wood, canoes and furniture. The sticky milky juice which exudes from cuts in the stem is used in making a kind of glue.

The breadfruit tree belongs to the *Moraceae* family, which also produces the osage orange. A somewhat similar, though inferior, fruit is produced by the Jack (*Artocarpus integrifolia*) growing in India, Ceylon, and the Eastern Archipelago. It is much eaten by natives in India.

BREAKFAST CEREALS. The modern breakfast cereals, whether brown and crisp and ready to serve from the package, or meant to be cooked into a delicious steaming hot dish, make the first meal of

the day quite different from the usual breakfast of only a few years ago. Then oatmeal porridge, cornmeal mush, boiled cracked wheat, or perhaps the old English dish "frumenty," made by boiling wheat kernels with milk and spices, were practically the only "cereal" foods used. The modern breakfast

foods, by making breakfast a simple, light, and wholesome meal, have done much to improve the diet of all civilized countries, especially for children.

This great change in the breakfast menu has developed an enormous industry. Every year new forms of breakfast cereals, cooked or uncooked, are placed on the market. We have breakfast foods flaked, malted, shredded, ground, cracked, rolled, and puffed. The Department of Agriculture of the United States tells us how they are prepared:

"The ready-to-eat brands are prepared in a great variety of ways. Some are probably simply cooked in water and then dried and crushed. Some are made of a different mixture of grains, some have common salt, malt, and apparently sugar, molasses, or other carbohydrate material added

to them, some probably contain caramel or other similar coloring matter. Those with a flaky appearance are made like rolled grains, save that the cooking is continued longer. Those which look like dried crumbs are probably made into a dough, baked, crushed, and browned. The shredded preparations are made with special machinery which tears the steam-cooked kernels into shreds and deposits them into layers or bundles. Very many of the ready-to-eat cereals are parched or toasted before packing. This gives them a darker color, makes them more crisp, and imparts a flavor which many persons relish."

The puffed grains are most ingeniously made. Kernels of the grains are thoroughly cleaned, then they are placed in a gun-like cylinder and cooked with live steam. When the kernels have become thoroughly saturated with this exceedingly hot steam, they are shot from the cylinder into very cold air. Puff—the heat within the kernels bursts the cells and swells the grains to several times their natural size—

"BREAD" THAT GROWS ON TREES



Wouldn't it be wonderful if you could step out in your backyard, like this happy savage, and pick a dinner whenever you were hungry! Breadfruit may be baked and eaten fresh, or pounded to a pulp and allowed to ferment, forming a sour paste much relished by the Pacific islanders.

"shot from guns," as some advertising genius called the process.

The first cereal breakfast food was probably made from oats, and that grain is used more largely today than any other in the making of breakfast foods. Let us see the processes by which the grain that pours from the threshing machine is changed to the "rolled oats" with which we are so familiar.

When the selected oats arrive at the mill they are sucked up into large storage bins through big iron pipes, to remain there until they are milled. Then they are thoroughly cleaned, and the ends of the grains are snipped off in a machine equipped with little clippers to aid in removing the hulls later on. Next comes the roasting, the most important part of the making of oatmeal, rolled oats, or other cereal; for by roasting the oil in the tiny cells is released and the whole grain flavored by it, just as in coffee roasting. This roasting is done either in a kiln dryer, where hot air coming from below keeps blowing the grains up in the air and stirring them about—a wonderful device that is capable of drying a carload of oats in about three-quarters of an hour; or by putting them through a machine like a coffee roaster; or sometimes even by roasting them in open pans over fires. After roasting, the huller takes the oats and passes them through rollers so set that the hulls will be slipped off. If any kernels get through without having their hulls removed, the "tailer" slips them back to go through again. Some are sent through rollers three or four times. The hulls are blown away by blasts of air.

Softened by steaming the grains, or "groats" as they are now called, pass between big polished steam rollers that flatten them into flakes. Then they are poured into boxes, sealed by machinery, and dried in heat sufficient to kill any lurking germs.

The by-products, such as the hulls, middlings, and oat-dust, are sold to stockmen for mixing with other feeds.

BREMEN (*brā'mĕn*), GERMANY. Can you imagine New York City, Philadelphia, or Baltimore as a part of the United States and at the same time a republic in itself? This is the queer position of the three so-called "free cities" of Germany—Hamburg, Lübeck, and Bremen. Founded in the Middle Ages, these cities early became important commercial centers (*see* Hanseatic League), and gained the right to manage their own affairs. Although they entered into the federated German Empire in 1871, they retained their rights of local self-government much as our states retained similar rights when they became parts of the United States.

Hamburg and Bremen have developed into the two leading seaports of Germany. Bremen, the second in rank, is situated on both banks of the Weser River, about 50 miles from its mouth. On the left bank is the new section, composed chiefly of residences along wide well-paved streets, while on the narrow winding streets on the right bank are to be seen the old council house

and the merchants' hall, side by side with the new cotton exchange and other modern business buildings.

Smaller vessels can come up to the docks in Bremen, and the offices of all the great shipping companies are in the city; but most of the large ocean-going steamships dock at the city's port, Bremerhaven, which is only ten miles from the open sea. Through this port passed most of the trade between Germany and America before the World War of 1914-18. The United States sent to Bremen cotton, tobacco, rice, grain, petroleum, and timber, and received from it aniline dyes, cotton hosiery and laces, woolen cloth, and children's toys. From it, too, came the greater number of the German emigrants to America, for it was the headquarters of the Great North German Lloyd steamship company.

The district ruled by Bremen has an area of 99 square miles, of which one-half is meadow and pasture land, and one-quarter is under tillage. Population of the city of Bremen, about 250,000; of the whole district, 300,000.

BREST, FRANCE. Near the tip of the rugged coast of Brittany, in northwestern France, lies the great seaport of Brest, one of the most important French naval stations, and the scene of several historic sea battles between England and France. Ships enter the wide rock-bound harbor through a narrow strait guarded by a formidable system of modern forts.

The city is built on the steep slopes of two hills, separated by the Penfeld River. An imposing castle and donjon, built between the 12th and 16th centuries, stand above the river mouth. Between the town and harbor mouth, the Cours d'Ajot, one of the finest promenades in Europe, skirts the shore.

Brest was one of the principal ports used by the American Expeditionary Forces in the World War. Many of the soldiers who were quartered there retain vivid recollections of the discomforts, due to rain and mud, before the hastily-built American barracks and drill grounds had been adapted to the unfavorable climate. Before the war was over, American engineers had made large and permanent improvements in the harbor and railway facilities.

Important sardine and mackerel fisheries have their headquarters at Brest, as well as large flour mills, chemical plants, and other varied industries. But the life of the city centers chiefly around the French naval gun foundries, ammunition factories, shipyards, and repairing docks. A submarine cable runs from Brest to America, and many transatlantic passenger lines touch here. Population, about 90,000.

BRICK AND TILE. The story of bricks carries us back to the dawn of civilization, for almost as soon as men began to erect temples and palaces, they learned that a cheap and durable building material could be obtained by molding clay into rectangular masses and allowing it to harden, either in the sun or in artificial heat. Kiln-burned bricks made by the Babylonians 6,000 years ago still exist, and the entire site once occupied by the vanished city of

Babylon is little more than a huge mound made by the breaking down and dissolving of the former huts and houses of sun-baked brick.

Egyptians and Bricks

The ancient Egyptians had an inexhaustible supply of brick-making material in the clay which forms the bed of the river Nile, and brick-making was always one of their chief industries. Because this clay lacked tenacity, the Egyptians used to add chopped straw or reeds, which served to bind the bricks together. You remember how the children of Israel during the mournful years of their bondage in Egypt were set at making bricks, and how the cruel taskmasters added to their woes by requiring them to make "bricks without straw"; that is, ordered them to furnish their own straw without diminishing the quantity of bricks produced in a given time. The Egyptian bricks were nearly all sun-dried, not kiln-burned, and so were like the *adobe* bricks of Mexico and the southwestern part of the United States which are still used where there is no frost to freeze the moisture in the bricks and crack them.

materials close at hand. The industry is widely scattered because bricks can be made of almost any kind of clay, mixed with sand. Brick clay consists largely of hydrated silicates of aluminum, with oxide or carbonate of iron, and various other substances.

HOW EGYPTIAN BRICKS WERE MOLDED



The mixture of clay and chopped straw was packed by hand into individual molds and then piled up in the sun until partly dry. Then the mold was taken off and the drying completed. Egyptian bricks were rarely baked with fire, so that most of the ancient brick buildings in the Nile valley have crumbled.

ANCIENT BRICKMAKER AT WORK



This Egyptian slave of the days of Rameses the Great is shown mixing the Nile clay with chopped straw to make the building material for some great temple. He is using a primitive type of hoe, while a slavedriver stands over him with a whip.

When they are burned, bricks of this composition have a buff, salmon, or red color, due to the presence of the iron. If much carbonate of lime or chalk is present, the color is sulphur-yellow. If sand is not already present in the clay, it must be added. If there is too much sand the bricks are likely to crumble, and if there is too little the bricks will easily crack.

Biography of a Brickbat

In making bricks, the clay is thoroughly cleaned and mixed with water in what is known as a "pug-mill." In this are rotating blades which cut and thoroughly mix the clay. Sometimes anthracite coal dust is added to help in the burning of the bricks. The mixture then goes to the brick-making machine, except in small plants, where it is molded by hand. There are three general types of machines—the soft-mud machine, the stiff-mud machine, and the dry-clay machine. In the stiff-mud process, which is the most generally used, the machine has a trough, with a feed hole at one end and a delivery hole at the other. A central shaft carries heavy knives, so arranged that when the shaft is turned the clay is thoroughly mixed and kneaded, and forced through the rectangular opening in a column of soft brick. This column is cut in proper lengths by wires. This process produces a slightly harder and more durable brick than the soft-mud process, in which machinery presses the mixed clay into molds. In the expensive dry-press process the clay is almost dried before it is introduced into the machine, and the bricks are made in steel molds under

Today brick-making is one of the world's great industries. You will scarcely find a community of any size without its own brick plant, unless it has an abundant and cheap supply of other building



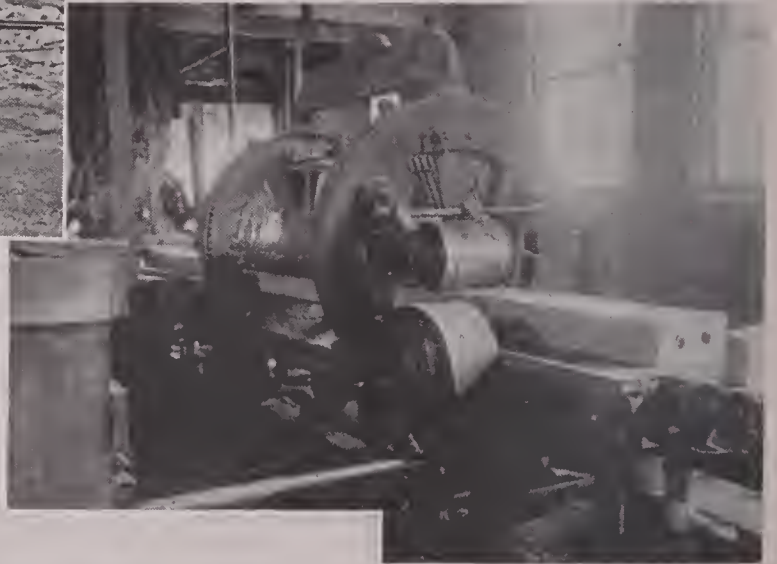
great pressure. Most of the finest brick for artistic front wall or decorative interior work is made by this process.

Out of the Drying Tunnels into the Fire

From the machines the bricks go to the drying tunnels, to be dried for about 24 hours in a moderate temperature before being burned in the kilns. Sometimes they are piled in the open to dry slowly, but artificially dried bricks burn more evenly. The drying tunnels are heated usually by the exhaust heat from the kilns, and the atmosphere must be kept dry by ventilation devices. If the air gets too moist, the surface of the brick remains damp

for some time and the moisture from the interior comes to the surface as water, carrying with it the soluble salts of the clay. These salts are deposited as the water evaporates, leaving the white scum often seen on improperly dried bricks.

The bricks are now ready for the most important part of the process—the burning.



On this depends very largely their strength and durability, as the action of the heat brings about chemical actions which entirely alter the structure of the clay. The bricks are piled in kilns so arranged that the fire may reach every part of them. Sometimes the bricks themselves are

piled to make their own kiln and a fire started inside; by this method a great number of bricks may be burned at one time. The firing takes from 10 to 15 days according to the method employed. Bricks for ordinary purposes are kept at a cherry-red



Here we see how bricks are made today. A steam shovel digs clay and loads it on a narrow-gauge railway train. Next we see a long bar of kneaded clay passing through a machine which cuts it into brick sizes. In the center is a view of a brick plant, equipped with "down draft" kilns. The bricks are piled inside those round huts; the fire, which is built in the center of the kiln, strikes the rounded roof and passes down through the spaces between the bricks to a flue beneath the floor, which leads out underground and up into the neighboring tall chimney. In the next picture, workmen are shown firing one of those kilns. At the bottom expert brick-makers are examining the bricks after the kiln has cooled. You can see inside the kiln how the bricks are piled on edge with spaces between them, through which the heat passes.



For any subject not found in its alphabetical place see information

heat, with a continuous sheet of roaring flame filling the whole interior of the kiln. Others for finer purposes are raised almost to white heat.

Various Types of Brick

Paving or vitrified brick must be very hard to withstand the wear of heavy traffic. In making these bricks, lime is added to the clay and the burning is done at a more intense heat than in making common brick. Facing bricks, those which occupy prominent positions in fine buildings, are put into a re-press before they are dried, which squares the corners and edges and gives them a smooth surface; sometimes they are specially surfaced, as in so-called "tapestry brick." Fire brick, for lining furnaces and fireplaces, is made to withstand the heat by using clay that has in it very little if any fusible materials.

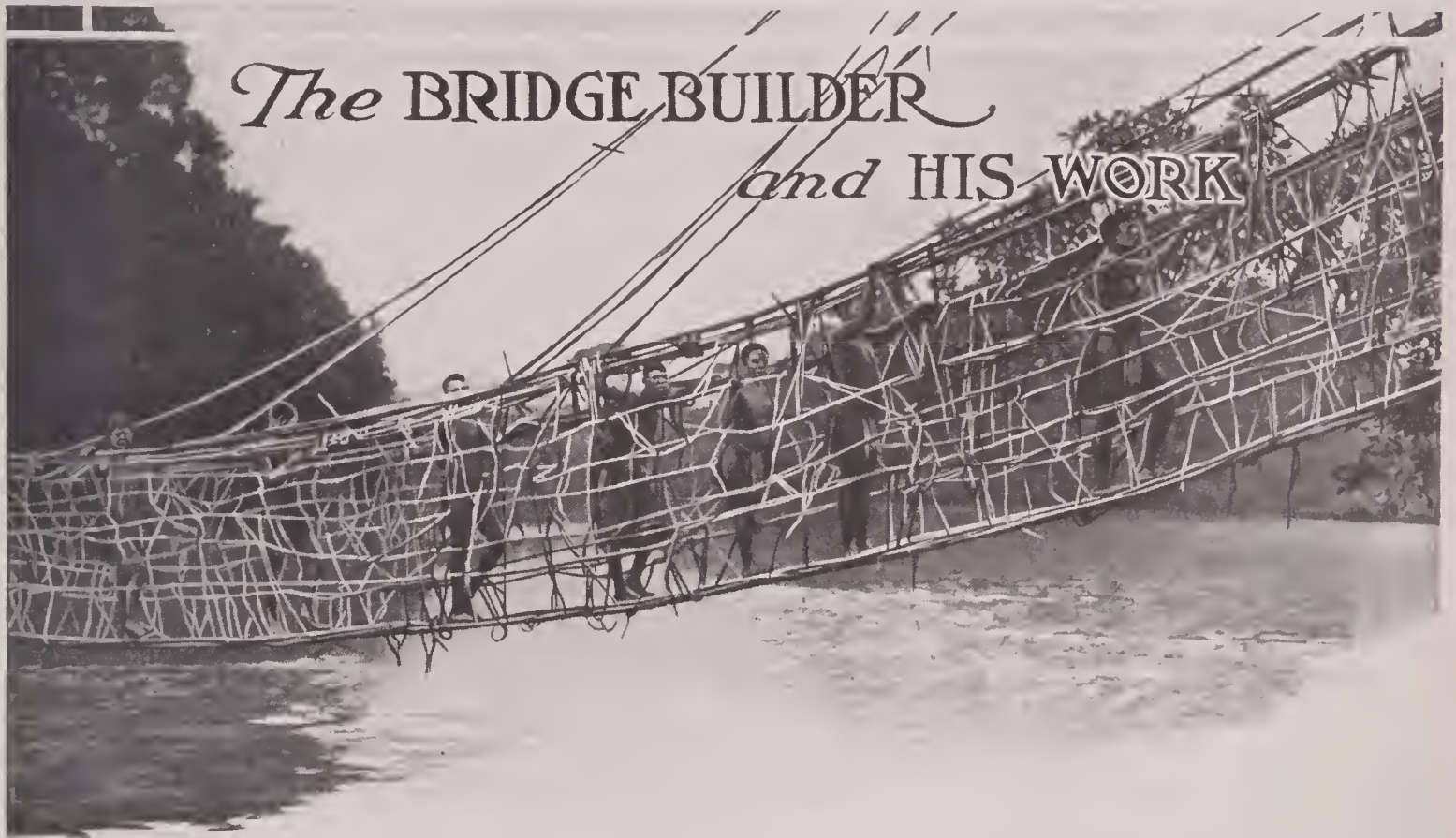
The size of the American brick varies slightly but

is usually 8 inches long, 4 inches wide, and 2 inches thick. In England the bricks are slightly larger.

Tiles are made in much the same way as bricks. They are of various shapes and patterns, and they have a wide range of uses in building, such as covering roofs, paving floors, and for many decorative purposes. Hollow tiles are used for drains and for chimneys, and to a great extent in the construction of fire-proof walls, floors, and partitions.

The most common form of tile is that used for drains and sewers. Machines make these drain-pipes of ordinary brick clay by squeezing a continuous length of clay through an opening, as a soft hollow tube; this is then cut to proper lengths, dried, and burned in a kiln. Roofing tiles are made by compressing pulverized clay in metal dies under a steel press, and then firing, after which they are decorated and glazed.

Fine wall and floor tiles, sometimes known as *encaustic* tiles, are made of especially pure grades of clay, which is dried, ground to powder, subjected to heavy pressure in metal molds, and then baked. For floor purposes unglazed tiles are used, often laid in patterns of different colors. Glazed tiles are used for walls of bathrooms and kitchens.



The BRIDGE BUILDER *and HIS WORK*

BRIDGE. A tree trunk fallen across a stream, or a stout vine growing over a ravine served very well as a bridge for primitive man. Stones and timbers placed in the stream as props make it possible to build longer bridges, and tough vines woven together form rude hammock bridges suspended from bank to bank. A single strip of rawhide makes a native bridge in out-of-the-way India, and holding to a stick hooked over this cable the traveler is hauled across the stream by someone on the opposite bank. Man does not go far on the road to civilization before the pathway bridge becomes a highway bridge for horse, cart, and wagon; and finally the "iron horse" with its thousand-ton loads of freight demands new and stronger bridges.

What miracle workers the modern builders are, and what wonder-bridges they have built! The "suspension" or hanging bridge, to which type belongs the strip of rawhide, and the hammock bridge of vines, becomes the giant network of steel cables strengthened to bear aloft a firm level roadway.

Three of the largest suspension bridges in the world span East River at New York City. In the famous Brooklyn bridge two huge towers of masonry hold aloft four steel cables from which the roadway is supported. To make the cables, more than 5,000 steel wires are woven into a rope as large around as a man's body. Downward over the stream they curve from the towers and back to land on the other side, where their ends are anchored securely in blocks of

masonry buried deep in the earth. The other two suspension bridges—the Manhattan and Williamsburg bridges—have been built since the Brooklyn bridge, and steel towers are used instead of masonry. The Williamsburg bridge has a river span of 1,600 feet, the longest span in any bridge of its type, and the Manhattan bridge is said to have the largest carrying capacity of any bridge in the world. The four cables of this bridge could support a weight of 20,000 loaded army trucks or of two great ocean steamships.

Hellgate bridge, another notable New York bridge, has the largest arch in the world. It is a steel arch with a 1,000-foot span, carrying four railway tracks. The Romans were the first to use the arch construction successfully in their famous stone aqueducts and bridges, but they used a series of arches and did not attempt to build spans of more than 50 feet. In the Key West railroad, modern engineers, using 48 coral islands called “keys” as stepping stones, have built a series of arches to carry a railroad over 100 miles of open sea between the mainland of Florida and Key West. In vain the ocean storms hurl their fury against this sturdy pathway across the waves.

Over the Firth of Forth in Scotland, 51,000 tons of steel have been woven into a giant bridge holding aloft two railway tracks so firmly that express trains may safely pass at a speed of 60 to 70 miles an hour. Even in violent storms that wreck ships at its base and blow men off their feet, this bridge stands secure. To rivet the steel plates and beams together, more than 6,000,000 rivets were required. From 4,000 to 5,000 men worked on the bridge, and it took seven years to build it. It has 145 acres of surface to be painted each year.

This bridge is one of the most famous of the “cantilever” bridges. Its two spans are 1,710 feet long, the longest span ever built until the completion of the Quebec bridge, with its single span of 1,800 feet, also of the cantilever type.

The Bridge that is Built Like a Bracket

The cantilever bridge is called a bracket bridge because each end of a span is built out like a bracket braced on a firm foundation, and a center portion is then riveted to the ends like a shelf supported on wall brackets. Cantilever bridges, like suspension bridges, can be built in long spans, so these types are chosen where center supports would be a hindrance to navigation, or where the water is deep and swift, making difficult the building of piers.

A log over a stream is the type of the “girder” bridge. Two logs or beams with cross-pieces laid over them make the common highway bridge of the girder type. With steel beams or “trusses” very substantial bridges of this type are built, but construction is limited to comparatively short spans. Many viaducts built to carry railroads over valleys are of this type, as are also the elevated railway tracks.

Girder bridges, cantilever bridges, and suspension bridges are the main types, but there are many other kinds, for practically every bridge gives the engineer

new problems to work out. Especially interesting are the movable bridges constructed so as to permit large ships to pass. Some, called bascule bridges, are divided in the middle and tilt up like the blades of a jack-knife. In others a central span turns on a pivot, or is lifted up the sides of towers built for that purpose. Of this latter type, the most famous example is the Tower Bridge at London. Opening and closing of such bridges is done very quickly by machinery, often electrically operated, so as not to delay either the bridge or river traffic. The “pontoon” bridge or bridge of boats is another odd type which has been used by armies from time immemorial. At times pontoons are even used as permanent bridges, although they are a barrier to the passage of boats. Here and there we still find the picturesque old covered wooden bridges built a century or so ago. And dating from a yet remoter past are those quaint old bridges—such as the still standing Ponte Vecchio of Florence, Italy, and the former London Bridge of nursery fame—whose roadways were lined on each side by shops and houses.

Do You Like Adventure? This is the Life for You

If you like adventure, consider the life of the bridge builder. Looking through his eyes and listening with his ears, we find the mighty bridges alive again with the industry of their building. Men ride the great steel beams as they are swung up to their lofty position by snorting puffing derricks. Men climb up the framework of the bridge and run across beams far out over the water busy with their work of placing, riveting, hammering, until the whole structure hums like a giant beehive.

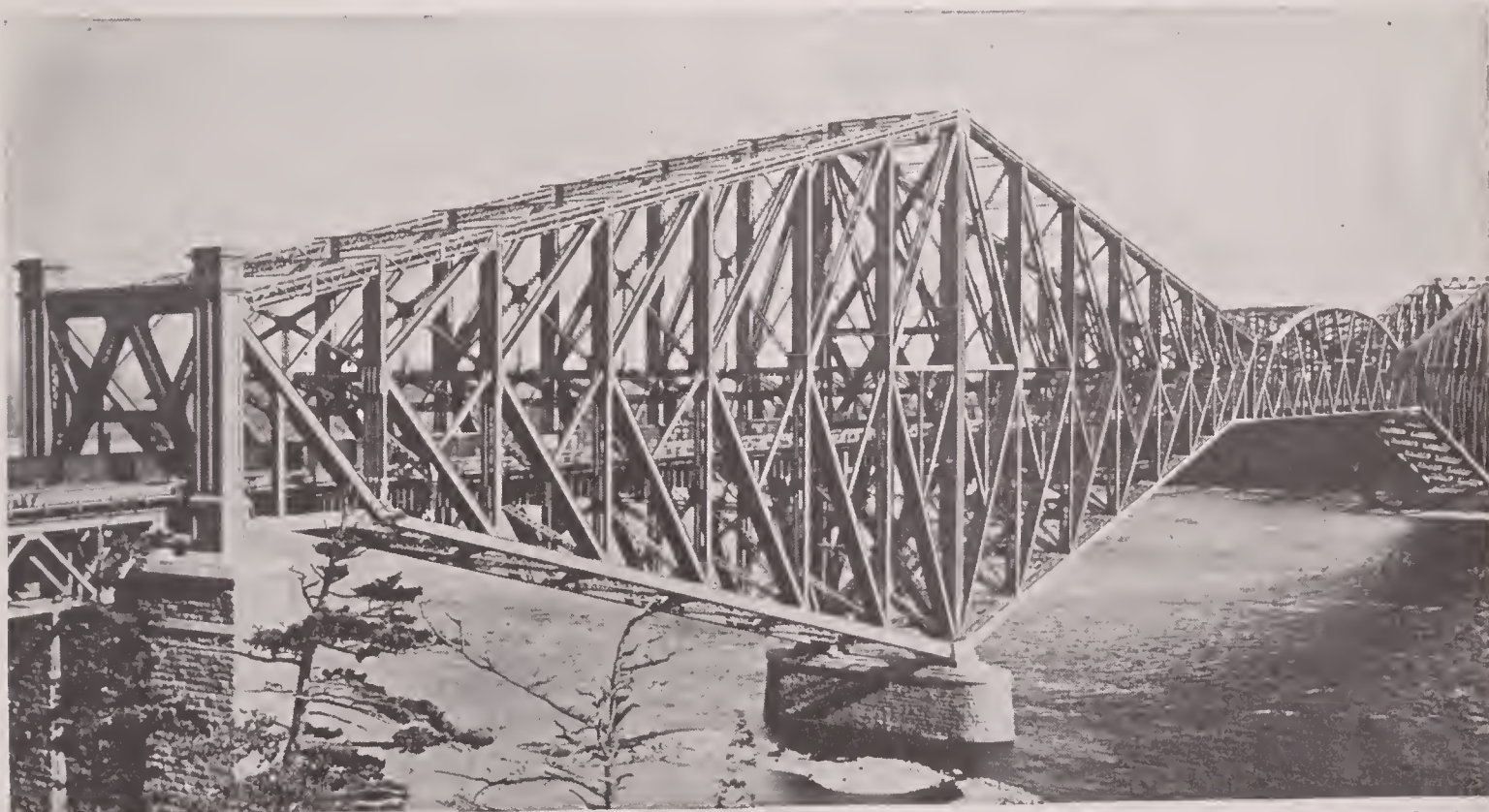
To work his triumphs the bridge builder chooses his material with care and often brings it from great distances. Steel for the making of giant bridges must pass severe tests of strength and endurance. Samples are put into machines that pound it with monstrous weights, bend and twist it, draw it out, and test it in every way, for the completed bridge must bear heavy weights and endure just such strains and stresses. It must bear the weight of all traffic that may at any time crowd onto its length. When a body of soldiers march in step over a bridge, the bridge vibrates and swings in rhythm with their step. Similarly the stopping and starting of street cars and the movement of all traffic on the bridge tests its strength more than an equal weight at rest. The strong winds wrestle mightily with the bridge, and the modern bridge builder has learned to take them into account for they may add to the burden of the bridge as much as 50 or 60 pounds to the square foot. Most mysterious of all perhaps are the strains due to changes in temperature. The material of the bridge contracts with the cold and expands with the heat with such irresistible force that the bridge builder must allow for a definite amount of lengthening and shortening of the bridge parts. Strange as it may seem, one-half hour of bright sunshine may be a more severe test of a bridge than the passage of a 350-ton train.



TWO FAMOUS EXAMPLES OF THE BRIDGE-BUILDERS' SKILL



This is the famous Tower Bridge over the Thames at London. As you pass over the driveway it has the solid appearance of an ordinary paved street. Yet when a ship approaches, this driveway splits in the center, and the two "bascules" swing up smoothly and easily, as if the two great towers were giants slowly lifting their arms. Meanwhile foot-passengers can climb the towers and cross to the upper bridge. The bascule bridge has become popular in many American cities, where a comparatively narrow shipping channel is spanned.



For spanning great distances the cantilever type of bridge has proved extremely successful. This famous railway bridge at Quebec, with a span of 1,800 feet, is perhaps the longest of its kind in the world. It is built in three sections, consisting of two huge brackets balanced on piers, and connected in the middle by a short truss. Such bridges can be built out from the balancing piers without a scaffolding to hold them up, for the network of braces makes them self-supporting at each step of the work.

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THE BRIDGE THAT WALKS A TIGHT ROPE

The great cables of a suspension bridge sustain the weight of the bridge and its traffic very much as that tight rope sustains the weight of the performer, the chief difference being that in the case of the bridge the weight is suspended below. The cables at either end of the bridge are anchored to bases in the ground. The two top pictures are views of the famous suspension bridge between New York and Brooklyn.



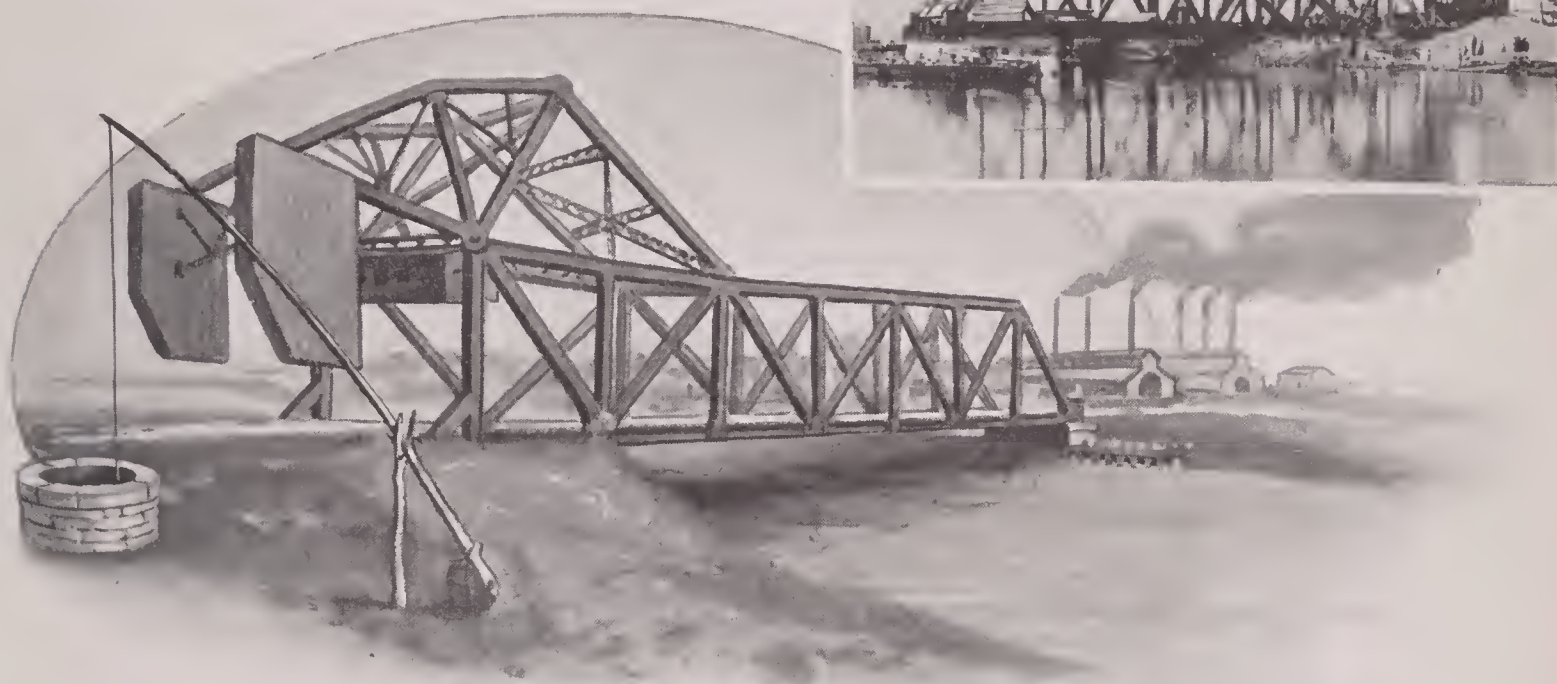
VAULTING OVER A WIDE RIVER

The arched bridge is not only one of the strongest, but also one of the most beautiful forms of bridges. The small drawing in the lower right-hand corner illustrates the principle of the arch, in which the weight is carried down each side of the curve to the supporting piers. Arched bridges of wedge-shaped stones locked at the middle with a keystone were favorites in ancient times. But today reinforced concrete is more often employed.



THE "JACK-KNIFE" BRIDGE

The two upper pictures illustrate the general principle of the "Jack-Knife" bridge. Such bridges are used over navigable streams with low banks, and are so counterbalanced with great weights, that they swing upward with comparative ease on their great hinges, following the ancient principle of the well sweep. Thus vessels are allowed to pass. Electric or steam engines usually provide the power for opening and closing these bridges.



THE "BOOK-SHELF" BRIDGE

These lower pictures show how the bracket principle which is so commonly used to support bookshelves is also employed in bridge building. The bridges, however, usually consist of double brackets forming what is called a "cantilever," balanced on a pier in the middle, with one side projecting out over the stream and the other side back toward the land.



BRIDGEPORT, CONN. The "industrial capital" of Connecticut and the second largest city in the state, Bridgeport is known especially for the variety and extent of its manufacturing interests. It is located on Long Island Sound, 54 miles northeast of New York City. The name of Bridgeport has long been associated with sewing machines and firearms. The Wheeler and Wilson sewing-machine company moved their plant here in 1856, and the Howe factory came in 1863; and the Union Metallic Cartridge Company, also located here, is the largest cartridge factory in the world. Besides these, there are large manufacturing of corsets, silver and plated ware, automobiles, phonographs, electrical supplies, machinery, hardware, rubber goods, woolen goods, and of aluminum, bronze, and brassware.

Perhaps the best-known citizen Bridgeport ever had was Phineas T. Barnum (1810-1891), the great showman and prince of advertisers. In his own autobiography he tells how he started his fortune by buying an old slave woman and showing her as George Washington's nurse. He founded a dime museum in New York, and presented Tom Thumb, a dwarf two feet high, to crowned heads in Europe; he brought Jenny Lind, the "Swedish Nightingale," to the United States for a concert tour; exhibited the Siamese Twins; and started his great circus in 1871. He made Bridgeport his home, housed his circus there in winter, and developed the tract now known as East Bridgeport.

Bridgeport harbor divides the city into three parts. The main city and the chief business center lie west of the harbor, with the wholesale district along the bank, the retail section farther back, and numerous factories along the line of the railway to the west. "East" Bridgeport occupies a peninsula and here some of the largest manufacturing establishments are located. Summerfield and Newfield are east of the harbor. The Pequonnock River and the harbor arms are spanned by half a dozen bridges.

Bridgeport has excellent transportation, both by rail and by water. There are daily steamboats to

New York City and across the sound to Port Jefferson, L.I. The city and its attractive suburbs are the home of many people whose business interests are in New York City, and it has several excellent parks which make attractive recreation spots for its great industrial population of many nationalities.

The first settlement was made in 1639 on lands bought from the Paugusset Indians, and was known as Pequonnock. In 1800 the borough of Bridgeport was incorporated. Population, about 145,000.

BRISTOL, ENGLAND. The dignified old city of Bristol has from the dawn of its history been a trading center. Situated at the junction of the Avon and Frome rivers, it can be reached by large steamers, and each year millions of dollars' worth of exports and imports pass through its harbor. The city has long been famous for its glassworks, potteries, soapworks, tanneries, tobacco factories, and shipyards. In the latter was built, in 1838, the *Great Western*, the first steamship to cross the Atlantic.

About the year 1000 a Saxon settlement began to grow up at the junction of the two rivers, and by the time of the Norman Conquest, in 1066, it had attained considerable size and importance. From Bristol the Cabots sailed on their voyage to explore the New World found by Columbus. Bristol fishermen settled Newfoundland, and it was the home of Admiral Penn, father of the founder of Pennsylvania. It was also the home of the poets Coleridge and Southey, and many landmarks recall the former glories of the town. Supreme among these relics is St. Mary Redcliffe, called by Queen Elizabeth "the fairest, the goodliest, and the most famous parish church in England." This church was built in the 13th century, while the cathedral dates back to the middle of the 12th. Some of the schools are almost as old as the churches, their history beginning with the days of the Reformation in the 16th century. The principal institution for higher education, Bristol University, is extremely young, having grown out of University College, founded in 1876. Population, about 360,000.

The SUNSET GATEWAY PROVINCE of Canada

BRITISH COLUMBIA, CANADA. A wild chaos of forest-clad snow-capped mountains covers nearly all of British Columbia, the "Sunset Gateway" province of Canada.

Through the deep gorges and valleys between the mountains flow many swift turbulent rivers, turning and winding with an abruptness unparalleled in any other region of the world, as they strive to find their way to the sea. Here and there the mountain walls draw apart, leaving wide valleys and plateaus where fruits and cereals flourish.

On the side bordering the Pacific the mountains

Extent.—North and south, about 700 miles; east and west, about 400 miles; area, 388,263 square miles. Population, about 720,000.

Physical Features.—Chief mountains: Island Range on Vancouver and Queen Charlotte Islands, Coast Range (6,000 to 8,000 feet), Rocky Mountains (8,000 to 12,000 feet); highest peak, Mt. Robson, 13,068 feet. Rivers: Columbia, Fraser, Kootenay, Skeena, Finlay, Stikine, Peace, and Liard.

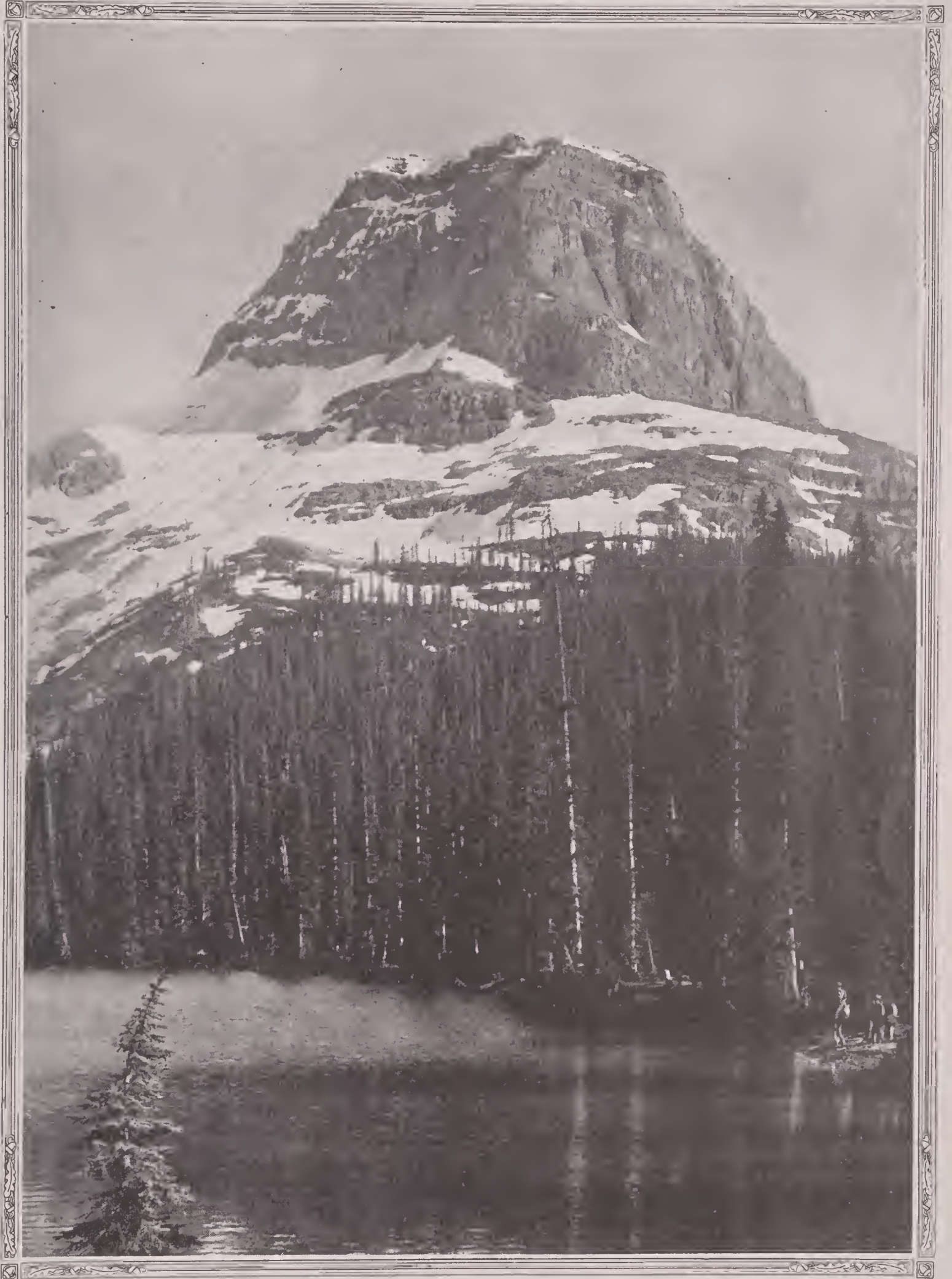
Products.—Lumber, pulp, and paper, ships; wheat, oats, hay, potatoes, etc.; copper, coal, zinc, gold, silver, lead; salmon and other fisheries and canneries, fish.

Cities.—Vancouver (115,000 population); Victoria (capital 60,000); New Westminster (17,000).

have been partially submerged in past ages, giving British Columbia one of the most remarkable coast lines in the world, everywhere deeply cut by sounds and inlets and gloomy fiords walled by

stupendous precipices, like the coast of Norway. Though the province is only about 700 miles from north to south, the coast line with all its indentations measures 7,000 miles—long enough, if straightened out, to reach to the southern tip of South America. The tops of some of the submerged mountain masses still stand above the surface of the ocean, appearing as a host of islands which thickly fringe the entire length

A SENTINEL PEAK OF BRITISH COLUMBIA



This scene is typical of the wild beauty of Western British Columbia. Here the Canadian Pacific Railway crosses the continental divide from Banff by way of Kicking-Horse Pass, and comes down the Wapta River. The peak is Mount Wapta on the Wapta River.

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VICTORIA, CAPITAL OF BRITISH COLUMBIA



Victoria is beautifully situated at the southern end of Vancouver Island on the Strait of Juan de Fuca. In the foreground is a yacht basin and at the left the big Empress Hotel. In the middle distance rise the splendid Parliament buildings, where the government of the province is carried on. The city began as a trading post and fort of the Hudson's Bay Company, established in 1843. It became the capital of British Columbia in 1868.

of the coast. Vancouver Island, with its area of 13,050 square miles and its rich deposits of coal, iron, and copper, is an important part of the province. On it is located the capital, Victoria (60,000 population), and on the mainland across the straits are the other chief cities, Vancouver (115,000), and New Westminster (17,000). (*See Vancouver; Victoria.*)

The two chief mountain systems are the Coast Range, rising sharply from the Pacific to heights of 6,000 to 8,000 feet, and the Rocky Mountains on the eastern side, where many of the peaks tower 11,000 and 12,000 feet above sea-level, forming some of the grandest scenery in the world. Between these two systems lie other less extensive ranges, notably the Selkirks, whose wooded slopes and enormous glaciers attract thousands of tourists. Great stretches have been set aside as national parks and reserves, which are becoming the Alpine playground of America.

To the west of the Rocky Mountains is a remarkable valley, 800 miles long and from one to six miles wide. In this rise seven of the great Pacific coast rivers, among them the Kootenay, Columbia, Fraser, and Finlay. The Columbia and its chief tributary, the Kootenay, take a bewildering course through the valleys between the eastern ranges, running north and south in great loops. Although they are so close at Columbia Lake that a canal a mile long connects them, they flow on, playing hide-and-seek with each other for hundreds of miles before they meet 20 miles from the United States frontier.

Vast Natural Wealth of the Province

Untold mineral wealth—coal, gold, silver, copper, lead, zinc, iron, and petroleum—lies locked in the depths of the mountains. Already production has reached a total of nearly three-quarters of a billion

dollars, and the industry is still in its infancy. Three-quarters of the province is covered with valuable timber, chiefly Douglas fir, red cedar, spruce, yellow pine, larch, and hemlock. The Douglas fir, which is not found elsewhere in Canada, makes the finest building timber of America. Its gigantic size—often 300 feet high and 15 feet in diameter—makes it especially valuable for the great timbers needed for trestles and wharves. Unlimited water-power is provided by the network of streams and lakes.

In the value of its fisheries, British Columbia leads all the other provinces. On the Fraser River are to be found some of the largest salmon canneries of the world, with an output in some years exceeding \$10,000,000 in value. When the salmon come up the river to spawn some of the streams are almost literally choked with fish.

Much fine farming and grazing land is found in the valleys and river deltas and on the lower plateaus and terraces of the interior. It is estimated that there are about 25,000,000 acres suitable for cultivation, of which less than half a million acres are being worked as yet. Fruit of the finest quality is produced in the southern valleys, notably the Okanagan and Kootenay districts in the southeast, while grains thrive in the valleys farther north. Irrigation is necessary in many parts of the interior, because the warm winds from the Pacific deposit their moisture on the western slopes of the Coast Range and pass eastward as dry Chinook winds. Along the coast these warm winds create an equable climate with mild winters and abundance of rainfall, but inland the extremes of temperature become far greater, with hot summers and cold winters. In the little-explored north the winters are almost arctic, because the Rockies are

here too low to act as a barrier against the icy blasts that sweep down from the interior plains and the Arctic coast.

When First the White Men Came

It was the discovery of gold in 1858 which first led to the settlement of British Columbia. Although the province had perhaps been reached by Sir Francis Drake in 1578-79, and certainly by Spanish explorers in 1774, and Captain Cook in 1778, no efforts had been made to settle it by Great Britain, except for the trading posts of the enterprising Hudson's Bay Company. Boundary controversies with the United States were settled in 1846 and 1872. When the gold rush came in 1858, a more efficient government was needed, and British Columbia was made a crown colony. For some years British Columbia stood out against federation with the rest of Canada, but the province finally agreed in 1871 to join the Dominion on condition that a railroad be built from coast to coast. This was the origin of the Canadian Pacific Railway which, with several other great railways, brings to the port of Vancouver large quantities of grain and lumber, thus making that city one of the important shipping centers of the western coast. Another Pacific railway terminus is at Prince Rupert, at the mouth of the Skeena River, 500 miles to the north. Area of British Columbia, 388,263 square miles; population, about 720,000.

BRITISH EMPIRE. Four great events in the 18th century changed the course of human history. These were the birth of the United States, the French Revolution, the Industrial Revolution, and—last, but not least—the founding of the British Empire.

This great colonial empire, which is scattered in every quarter of the globe and on which "the sun never sets," was built up partly by successful combat with the Spanish, Dutch, and French empires which preceded it, and partly by discovery and patient settlement.

By the method of conquest England in 1713 acquired from France Nova Scotia, Newfoundland, and Hudson Bay territory, and in 1763 France surrendered to her the rest of Canada. At the same date, which marks the close of the Seven Years' War (1756-1763), French influence was overthrown in India, and British supremacy was established there also. By settlement England acquired the Thirteen Colonies, which seceded from the empire in the American Revolution, as well as important possessions in the West Indies and elsewhere. It was the explorations of Captain Cook (in 1769, 1772, 1776), and the settlement of Botany Bay (1788) and Port Nicholson (1839) that gave her title to Australia, New Zealand, and other valuable possessions in the Pacific Ocean.

In the 19th century the British Empire steadily grew in size and strength. The beginnings of her African dominions had already been made on the west coast (Sierra Leone, the Gold Coast, Gulf of Guinea, etc.) in the 17th and 18th centuries. Cape Colony was conquered from Holland in 1806, while that coun-

try was aiding the French Emperor Napoleon in his wars against Great Britain. In 1843 the independent Dutch republic of Natal was added, and the victory of the British in the Boer War (1899-1902) brought the Transvaal and Orange Free State under the British flags. These British possessions, known since 1909 as the Union of South Africa, were enlarged at the close of the World War, 1914-18, when as a "mandatary" of the League of Nations the Union received German Southwest Africa. At the same time Great Britain, also a mandatary, was given German East Africa, now known as the Territory of Tanganyika. This connects the British possessions in southern Africa with those in the northeast, British East Africa (Uganda and Kenya Colony), the Egyptian Sudan, and Egypt, and so assures an "all-British route" for the Cape-to-Cairo railway. Egypt, the fertile land of the Nile, though occupied by Great Britain since 1882, was nominally a part of the Turkish Empire until the World War; now it is a regular British protectorate, though under its own Sultan. That same great conflict added also to the empire, as a mandatary, Mesopotamia and Palestine in western Asia; while all the former German islands south of the Equator were assigned either to the self-governing Commonwealth of Australia or to the Dominion of New Zealand. To all of these territories must be added Great Britain's other possessions—such as Gibraltar and Malta, in the Mediterranean; the Bermudas, certain of the West Indies, and the Falkland Islands, off the coast of America; Aden, Ceylon, the Straits Settlements, and Hong Kong, on the coast of Asia; together with many scattered islands valued as naval coaling stations and ports of call.

Altogether about one-fourth of the total land area of the globe is included within the British Empire, and one-fourth of the whole population of the earth owes allegiance to the British flag. But only about one-eighth of its population (including that of the British Isles) belongs to the white race. The rest are members chiefly of the black and brown races, natives of Africa and Asia.

The Secret of Britain's Power

How has Great Britain succeeded where other nations failed, and managed to hold together peaceably such scattered lands inhabited by such different peoples? France and Spain lost their old colonial empires, and Holland and Portugal have only remnants left. The secret of Great Britain's success is that she learned the lesson of administering her colonies, not for her own good primarily, but for that of the colonies. This lesson was taught her partly by the successful revolt of her Thirteen American Colonies. Something also was due to the Anglo-Saxon genius for self-government, which is one of the marked characteristics of her people. Gen. Jan Smuts of South Africa, who once fought with the Boers against Britain and then became a loyal British subject, has pointed out that the British Empire is really *a commonwealth of self-governing nations* rather than

an empire in the usual sense. It is, as he says, a "league of nations" in miniature. To colonies which are capable of governing themselves—to Canada, Australia, New Zealand, and South Africa—the fullest

larger place in the government of the empire, even to a voice in deciding its foreign policy and questions of peace and war.

The total area of the British Empire, including pro-

THE EMPIRE THAT ENCIRCLES THE WORLD



After a glance at this map you will realize the truth of the old saying, "The sun never sets on the British Empire." When it is midnight in London, the clocks in the far away Fiji Islands are ringing noon. The black portions of this map indicate the territory directly under British dominion; Egypt and the Anglo-Egyptian Sudan, which are under a British protectorate, are shown in shaded outline; while the former German possessions now under British mandate from the League of Nations are shown full-shaded.

self-government has been granted. Even to India, where Asiatic despotism was always the rule before the coming of the British, self-government under the British Raj is promised as rapidly as its peoples are made ready for it. Only places of strategic importance (such as Gibraltar) and those inhabited by barbaric races are permanently ruled as crown colonies, by officials sent out from London.

The Colonies in the World War

As was proved in the World War, when Germany expected the British colonies to revolt, it is loyal affection chiefly that keeps the great self-governing dominions true to their imperial mother, and the knowledge that they are safer and more prosperous in the Empire than out of it. A poet represents Great Britain as a lion and the self-governing colonies as its full-grown cubs, and thus expresses their interdependence:

The Lion stands by his shore alone
And sends, to the bounds of Earth and Sea,
First low notes of the thunder to be.
Then East and West, through the vastness grim,
The Whelps of the Lion answer him.

In 1914 several millions of the "Whelps of the Lion" answered the call. Canadians and Australians, South Africans and New Zealanders, and even native Indian peoples crossed the seas and fought and even died to save Great Britain and the British Empire from German conquest. As a result the British government is pledged to give her colonies even a

protectorates, etc., is about 12,000,000 square miles; its population, about 400,000,000. (See also England, and articles on the great self-governing colonies and India.)

BRITTANY, FRANCE. Wherever the French flag waves over a fishing-schooner, a trading vessel, or a warship—whether it be on the Banks of Newfoundland, on the China coast, along the fever-soaked shores of Africa, or among the tiny islands of the Pacific—you will find the sons of Brittany, those black-haired thick-shouldered sailors from the rock-bound peninsula which France thrusts westward into the Atlantic. For this province is inhabited by a seafaring race which for centuries has lived a life apart, gathering its living largely from the ocean or by cultivating the stony soil with patient obstinacy.

"The Breton peasant," say the French, "fears God and the sea and nought else in the universe." Indeed, these descendants of an ancient Celtic race have clung far more closely than other Frenchmen to their old religious faith. Everywhere along the wayside one comes upon tall crucifixes, and men in long blouses and wooden shoes, or women in quaint native costume kneeling before them. Nearby perhaps is a small church and a cemetery, with many crosses over empty graves, telling of brave men lost at sea.

The people of Brittany are melancholy and gloomy like the ocean fog, or gay and boisterous like the dancing wave. They are fierce fighters, with tempers

like the storms which smash against their coasts. They settle their private difficulties most often with their fists, avoiding law courts as much as possible. In time of war they fight for their country with equal courage and zeal.

But under the influence of modern industrial progress, the quaint old customs and costumes of Brittany are rapidly passing away. Its biggest seaports have become great naval stations or trade centers. Abundant crops are being raised in the river valleys, especially in the north where modern agricultural methods have been introduced. Among the important towns are the seaports of Brest and Nantes, and Rennes, the capital of Brittany in the old days when it was a semi-independent duchy.

In olden times this land was the home of the Armorican tribes, which came under Roman control about 51 B.C. Celtic fugitives from Britain, fleeing from the Anglo-Saxon invaders of the 5th and 6th centuries, settled in this peninsula and gave it the name of Brittany, "Little Britain." Through stormy generations it remained, most of the time an independent duchy, until it was incorporated with France in 1532.

Brittany has given many great men to the world, among them the medieval scholar Abelard, the explorer Jacques Cartier, the writers Chateaubriand and Ernest Renan.

BRONZE. Very early in the history of civilization men learned to mix copper and tin to make an alloy we call bronze. This mixture was harder than either copper or tin alone, and was used for swords, axes, arrow tips, and other weapons, before iron came into use. For this reason the period which followed the Stone Age of man's history has been generally called the Bronze Age.

In Europe this period extended roughly from 2000 to 1800 B.C.

Bronze is used in modern times to make big bells, for it has a rich tone when set in vibration by a sharp blow. By varying the quantities of tin and copper, the qualities of bronze may be greatly altered. In general the more tin that is used, the harder and more brittle will be the alloy. Bronze is also used for statuary, and for many art and industrial purposes.

The bearings of much heavy machinery, like the rings in which the propeller shafts of big ships revolve, are often made of a substance called "phosphor

bronze," in which a small amount of phosphorus acts as an additional hardening agent. An alloy called "aluminum bronze," in which the tin is almost entirely replaced by aluminum, is used for vessels which must withstand the corrosive action of certain chemicals. (See Alloys.)

BROOKLYN, N.Y. In 1898 Brooklyn, then the fourth largest city in the United States, was merged in greater New York. It lies at the west end of Long Island, across the East River from New York, with which it is connected by three huge suspension bridges, several subway tubes and railway tunnels, and ferries. Although called "the sleeping room of New York City," Brooklyn is in reality one of the greatest manufacturing communities in the United States. Its sugar refineries are the largest in the country. The milling of coffee and spices, the manufacture of machine shop products, ship building, and

the storage of freight at its giant docks are among its extensive industries. The New York Navy Yard at Brooklyn is one of the chief naval stations in the United States. As a "borough" of the city of New York, Brooklyn has its separate borough president, and controls such matters as streets, sewers, and other local improvements.

Brooklyn was founded by the Dutch in 1636 and named "Breuckelen," after a town in Holland. At the time of the American Revolution it had become a village of 3,500 inhabitants. On

August 27, 1776, Washington was defeated in the battle of Long Island, fought on the site of Brooklyn, and the village was held by the British until the evacuation of New York at the end of the war. At Fort Green (now Fort Green Park) were buried 11,000 Americans who died on British prison ships. In 1816 Brooklyn was incorporated as a village, and as a city in 1834. Subsequently Williamsburg, Flatbush, and other suburbs were annexed; and in 1898 this enlarged Brooklyn was united with New York City across the arm of the ocean known as East River. Population, almost 2,000,000. (See New York City.)

RELICS OF THE BRONZE AGE



These prehistoric articles of bronze, dug up in England, tell us something of the civilization of the Britons before the coming of the Romans. The round shield (1) was found in the Thames River; the "celt" (2) is a chisel-shaped weapon with a socket in which fitted a handle; the other relics are a bracelet (3), a spear head (4), a strange and deadly looking razor (5), a long dagger (6), and a crude sickle (7).

BROOMS AND BRUSHES. "Buy a broom! Buy a broom!" This monotonous cry of the street peddler or strolling broom merchant was once a familiar sound in the streets of towns and cities. But it is heard no longer, for now we buy our brooms and brushes prosaically over the counter.

Brooms are made by attaching dried fibers of the broom-corn plant to a long handle. First, a winding machine wraps wire around the ends of the fibers when they surround the handle. Then the broom, which is now cone-shaped, is put into a vise and flattened into the shape with which we are familiar, and sewed with heavy twine to hold it in shape. A scraping machine removes most of the broom-corn seeds which are still attached to the fibers, trimming is put on, if it is desired, and the brooms are ready to be packed and shipped. Whiskbrooms are made in much the same way, on a smaller scale.

More than nine-tenths of our brushes are made of hog bristles, though camel's hair and the hair of other animals are used for making fine artists' brushes. Scrubbing brushes are made usually of various vegetable fibers, the most common being rice root, "Mexican grass," "kitool" (a wood fiber boiled in oil, coming from the west coast of Africa), Tampico fiber (from the Philippines), and bristle fiber or *coir* (the husk of the coconut palm). In cheaper brushes the tufts of bristles or fibers are merely bound with thread, dipped into melted pitch, and twisted into holes bored in the wooden back. Better grades are made by binding the tufts with wires, which are drawn through the holes and woven together. A veneer is then glued or cemented to the back. Elaborate machinery is now used for nearly all processes.

The broom-corn plant is a member of the sorghum family. It has a cluster of rays at the top which bear the flowers. These rays, when dried, make the "straws" in our brooms. The plant is a native of East India, but is largely cultivated in the United States. An acre will produce from 500 to 600 pounds of "brush." Scientific name, *Sorghum saccharatum*.

BROWN, JOHN (1800-1859). The Civil War between the Northern and Southern states might have been delayed for several years but for John Brown's ill-fated raid on the government arsenal at Harper's Ferry, in October 1859. His subsequent death on the scaffold had the effect of crystallizing opposing opinions on the slavery question, and so hurried a divided country toward the supreme test of arms.

Born in Torrington, Conn., and descended from Peter Brown, carpenter of the *Mayflower*, this early abolitionist had all the piety, uprightness, and willingness to die for a cause that marked his Puritan ancestors. While a young man his eyes were so weak as to forbid sufficient study, thus preventing his preparation for the ministry. As a wool-grower, farmer, leather dresser, and surveyor, he and his large family of children dwelt successively in Ohio, Pennsylvania, Massachusetts, and New York, always brooding with the fervor of an Old Testament prophet on the sin of negro slavery, against which he swore eternal war. Such was his strength of character that

he made unfaltering converts of his young children and, when they grew up and married, of their wives and husbands. The whole family had a sense of dedication to a sacred cause.

At John Brown's command his sons emigrated to Kansas, in 1854, to aid in bringing that territory into the Union as a Free-Soil state. He soon followed them and played a leading part in that border warfare of bitterly contested elections and bloody fights. One of his sons was killed in the course of it, and another bore all his life the marks of prison chains. In a famous battle at Ossawatimie, with only 15 men, he held off 500 pro-slavery Missourians and won the nickname of "Ossawatimie Brown."

When the Kansas question was settled in favor of freedom, he formed a mad scheme for making war upon slavery in the South itself. On a rented farm at Hagerstown, Md., he gathered a few men, and on the night of Oct. 16, 1859, attacked the little town of Harper's Ferry. His purpose was to seize the United States arsenal there and procure arms for a slave uprising. He easily mastered the town and the arsenal, but was besieged by the local authorities, who were soon reinforced by a company of United States marines from Washington under Col. Robert E. Lee. Of the 22 men who participated in his raid, ten were killed, seven taken prisoners, and five escaped. Two of the killed men were Brown's own sons, and he himself was seriously wounded. As soon as his wound permitted he was tried for "treason, and conspiring with slaves and other rebels, and murder in the first degree." He was convicted and was hanged on December 2. His bearing at the trial produced an extraordinary impression of heroic simplicity and purity and grandeur of character. Within two years his tragic end took on a historical significance when Union armies marched to battle singing—

John Brown's body lies a-mouldering in the grave,
But his soul goes marching on.

BROWNING, ELIZABETH BARRETT (1806-1861) This gifted poet and wife of Robert Browning was such a precocious child and lover of verse that she read Homer in the original Greek at 14. Feeling social wrongs deeply, she wrote 'The Cry of the Children', a fine and poignant lyric that helped to rescue little ones from labor in English factories. An invalid most of her life, Robert Browning called her "a soul of fire in a shell of pearl." They were married in 1846 and he carried her away to Italy, where by the tenderest devotion recorded in literary history he kept her alive for nearly sixteen years. When she died in 1861 the city of Florence marked the house in which she had lived (called *Casa Guidi*) with a tablet, in gratitude for her sympathy with the Italian struggle for liberty. Her best known writings are her 'Sonnets from the Portuguese', in which she pours out her love for her poet husband-to-be; 'Casa Guidi Windows', dealing with the Italian patriotic struggle of 1848-49; and 'Aurora Leigh', a romantic narrative poem.





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